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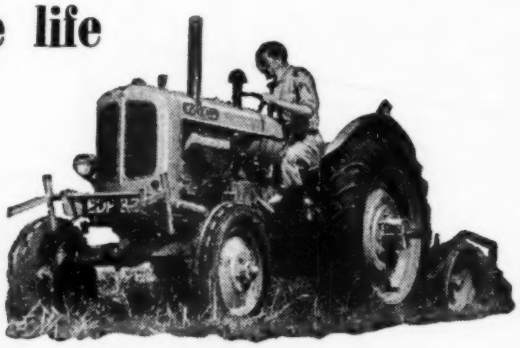

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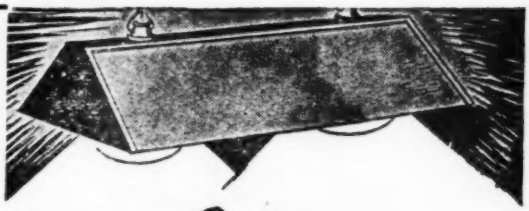

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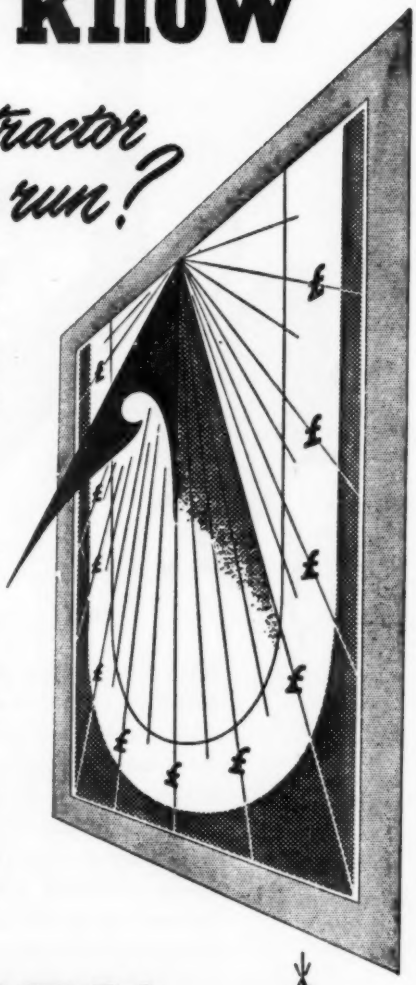

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VOL. LX No. 2 MAY 1953

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Sheep shearing gets under way in Warwickshire

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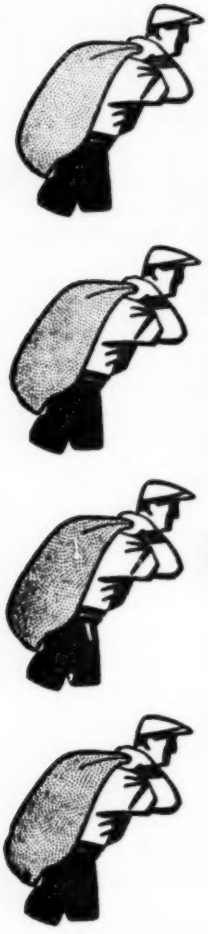

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VOL. LX No. 2 MAY 1953

RESEARCH FOR PLENTY

No. 7. HOW MUCH IS LEFT IN THE SEA LARDER ?

MICHAEL GRAHAM, O.B.E., M.A.

Director of Fishery Research,
Ministry of Agriculture and Fisheries

IN 1949 I attended a conference of the United Nations which I count to have been of unusual importance, in that it marked a change in attitude from the short-sighted materialism of the first half of the twentieth century to the, I hope, brighter and wider humanism of the second half. The conference was named " The United Nations Scientific Conference for Conservation and Utilisation of Resources "—nicknamed UNSCCUR. Originally it had been called in 1909 by President Theodore Roosevelt, but his successor, President Taft, cancelled it. This information came from Mrs. Gifford Pinchot, the widow of the Governor of Pennsylvania of that time. She was impatient that we had not been called to discuss how to make the resources available, which would mean overcoming the many human difficulties so often ignored in the past but fully recognized by this conference when it met.

The name of the conference, however, belonged to the past—"scientific," "conservation," "utilization," "resources"—all those words mean something utilitarian and materialistic. The idea was clearly a kind of stock-taking and sharing out (oh yes, I grant the sharing out) of material assets. This is the dream : of one orderly world in which impersonal and well-nigh perfect people direct the tangible assets to where they are needed, calling on modern technology to utilize them in the most economical way—and naught else is necessary. You will notice that people are not mentioned at all. There came to that conference more than 600 scientists from all over the world, bar Russia—and all were men who had studied resources.

The first conclusion that came from every section was that there was not, materially speaking, much shortage of resources—only for three or four metals, perhaps. And as for the common belief that the world population is outstripping the capacity of the land, Colin Clark at the conference gave us very encouraging figures. He made out that the world might well go short of food—but through the human factor, through not making food production a sufficiently attractive life to keep people on the land. I must leave it to land experts to deal with Colin Clark's evidence in the UNSCCUR volume, but I can say that this conclusion is true of the sea—as far as sea food will go. Fish cannot feed the world ; but it could do much more than it is doing.

RESEARCH FOR PLENTY :

The note that kept coming into the conference was sounded early on by a great man, Dr. Detlev Bronk—Chairman of the United States National Research Council : no less. " Man's welfare and survival demand appreciation of his biological needs. . . . If we are to shape a more satisfying life for men and women, the time has come to create a biotechnic civilization, proclaimed by Lewis Mumford, in which flesh and blood will be no less real than concrete and steel and the material products of science." How different that sounds from "conservation," "utilization," "resources". It is the missing piece that can make the wealth provided by technical advance (and potentially it is wealth formerly undreamed of) available to human beings. It is the metamorphosis of the twentieth-century dream, from "technic" to "biotechnic".

Some people will say, " this is all very well," but I can assure the sceptics that all my experience presses the same way, and the experience of others in the fish world as well. We had Hora from India ; Bottemanne from the Netherlands East Indies ; Walford of the United States, who travels the world over on fisheries ; Needler and Pritchard from Canada, and others : men of widely different temperaments, all of them world authorities—and we were completely at one. I should like to say a little about both our main findings.

Pond Culture in Warm Climates One was about the cultivation of fresh- and brackish-water fish in warm climates. Here we all agreed that there is room for very great expansion : here, there, and everywhere, among the millions of villagers in tropical countries who are at present starved of protein. The greatest skill in the art of cultivating fish in ponds is in China, secondly in India, and we want to see their methods spread around the world. And here let me say that our own Colonial Office, advised by that extremely active and understanding fishery naturalist, C. F. Hickling, had been doing just that, within the Colonies, for four or five years before the conference met. It was his idea, in fact. As an Englishman I am proud of that. And, from the same pride, I will refer at this point to the English initiative in the study and conservation of whales, about which Dr. Mackintosh spoke in the B.B.C. Home Service last June.

To come back to pond culture of fish in warm countries—where I would remind you that it is almost an impossibility to transport fish in a state of freshness to the millions who need it—we claimed that in terms of human betterment one could hardly do anything more useful than to show people how to get protein when their lives were miserable for lack of it. But we warned the full conference that success would depend on " human cunning and tact " in dealing with all the variety of ponds and lagoons and water-courses. Our skill must be no less subtle, though more scientific, than the traditional fine discrimination of the Chinese masters of the art. " We would build on ancient skill, but spread by scientific understanding."

Now, a sceptical materialist may be considerably disturbed to find that a world-wide group of applied scientists met only to recommend that the Chinaman of today and the future should obtain his protein as his ancestors did. The materialist's mind would turn rather to projects such as feeding on plankton, electric fishing, or fertilizing the sea. He may, too, have heard about seaweeds, which are, as it happens, a good deal more promising. Admittedly, there may, in some very favoured situations, be some use for electrocuting fish where they are already well concentrated. Indeed, if we are to accept an article in a Russian boys' paper, the Russians have found

electrocution useful in a salmon river. We also think the method possibly promising as a research tool, even in sea-water, perfect electrical earth as it is. But as a major contribution to world food problems, none of those suggestions is worth considering. Plankton consists of small creatures, vegetable and animal, many of them microscopic, occurring in favoured parts of the oceans in great numbers, and in small numbers everywhere. I have cooked and eaten plankton : I found it an amorphous mass, with the faintest suspicion of a flavour of shrimp paste.

However, men *could* live entirely on plankton. These organisms form the basis of life in the sea as, shall we say, grass and earthworms represent the basis of life on land. From the nutritional point of view, a man can doubtless live entirely on grass. The only evidence we have is to that effect : a man in London who wrote to *The Times* and said he did so. Or we may consider rats and mice. They are edible. There exist instructions for cooking them : a large rat needs twenty minutes' boiling, a mouse five to ten minutes according to size. But we must remember that Frank Buckland found that London mice did not taste as good as those he used to eat at Winchester. And with the rodent reproductive rate, and their cleanliness and docility . . . but this is nonsense ! I am sure that Sir James Scott Watson is not plagued by suggestions to solve our food problems by eating grass or mice. It seems that even the dreamer of the first half of the twentieth century knows, without knowing that he knows them, the operational factors against a grass diet, or a worm diet, or rat cultivation, including the human factors—as always, the most important ; but being a dreamer, thinking only of the technology, instead of thinking first of the people, he soon gets lost away from home. The proper answer to the three proposals I have mentioned is " Rats ! ", and I will not waste your time now with patiently reasoned answers.

Chart of Underfished Waters Those suggestions are seen to be merely minor projects when we turn to the second main work of the fish section at the conference. This was to make a chart of the world showing " latent fishery resources". The chart made a considerable impact on the conference, because as a result of the combined knowledge of all of us, we were able to write against every continent except Antarctica, and on both sides of every continent, at least one major population of good, healthy, edible fish that we believed to be underfished. Such are the great resources of the sea—uncountable millions of good, sound fish, and most of them catchable by known methods.

A world chart full of names of underfished stocks makes plankton skimming or throwing fertilizers into the sea look a little foolish, and to us in England it seems particularly foolish to search for magic when one of those names on the chart is marked on our own doorstep. That name is *herring*.

Here, I will leave all the other entries on that chart, even the teeming redfish of the Atlantic, and the Arctic cod—which is my own present subject of research with a team of men of whose achievements we are proud—even the uncounted pilchards, which are virtually untouched by fishing, all round the world but including those of the English Channel near home, and I will speak of the herring stock, its situation and research on it, in more detail. It will stand for the rest. I am favourably placed to talk herring-sense, because Dr. W. C. Hodgson, who is pre-eminent in this field, is my lifelong colleague and friend.

The Declining Herring Industry Thirty-two years ago, when I joined fishery research, the herring fishery of East Anglia was as characteristic as its marshes and broads. Indeed, countrymen joined in the fishery during the ten weeks of its season after harvest was in, as they doubtless did in the Middle Ages when St. Benet's priory paid its royal dues in herrings. I was told that in 1913 no less than 1,600 drifters, English and Scottish, joined in the fishery. In that year, 7 million cwt. were landed in England and Wales, 4 million in the East Anglian fishery. Now, 7 million cwt. comes out at about two-thirds of our present meat supply, which is a lot for one kind of fish. Moreover, the herring is usually on sale at about half the price of the cheapest kind of white fish ; and it is more tasty. It is as good as a trout or salmon.

I soon learned, after I was married, that a herring in some form or another could often take the place of an egg at a meal, and is usually cheaper. Even now, when my kipper costs from 3d. to 3½d., an egg costs from 5d. to 6d. And nature has provided that at the season when eggs become scarce herrings become abundant, and vice versa. Here, then, was a most valuable resource. What has happened to it ? In 1929, when I used to go to sea in drifters, 1,100 took part in the autumn fishing. There were no new ones, or almost none, and the largest of them shot two-and-a-quarter miles of drift nets. Now there are between 300 and 400, each shooting a little over a mile of nets, and still these are mainly the same drifters. And the men ? In place of the 10,000 to man 1,100 ships, there must be less than 4,000 now who know the art and have the hardihood, energy and courage to take part in the herring fishery. All too few of these are new men. And a smaller fleet means less searching power, less chance of someone finding the herring for the fleet to concentrate on.

This is a sorry tale to put beside the twentieth-century dream. You may naturally ask why this has happened. The herring have not been overfished: by every test that we can apply, this stock is there to be taken. It has shown none of the signs of full exploitation, whether in former years or now. I do not know why housewives do not demand all these herring. Instead, the industry has to keep looking at its export market, formerly great but now small. The housewives could have many more herring if they wanted them ; but, if they all asked for as many as my housewife does, they would find that there are not enough men to take the 1913 catch. Why not ? Among other factors, fishermen are like other people in that they want understanding of their qualities and appreciation of their sacrifices, which, in the wonderment of the mechanical dream, the young fisherman does not receive.

The herring problem is a problem of people, at the production end as at the consumption end, and, for all I know, in the middle of the chain as well. Technology comes second. The same is true of the other fish resources on our chart. World fish production is estimated at 20,000,000 tons. As far as the fish go, I am sure that that figure could be doubled, yes trebled, or quadrupled. But even when on our very doorstep it is out of reach until we cease to give all the honour and guerdon to the makers of our magical toys—oh yes, and conjurors' foods: something out of a secret packet, highly decorated.

Fishery research was demanded first by fishermen, in their papers read to an international conference in 1883. Since then the scientists have always worked with the fishermen, and on tasks that seemed to fishermen to be worth while. The uncertainties of drift-netting, in which the herring's action,

not the fishermen's, is the operative cause in capture, have led to forecasting of the fishery—nineteen times a year now—so as to steady the market a little by doing what we can to guide the operators on their scale of operation—how soon to come, what nets to provide, how much shore equipment to order.

To the same end, the steadying of the trade, we have encouraged other methods of fishing, such as the ring-net, in those relatively quiet waters and seasons when it can be used. In this method the fisherman takes the herring, instead of capture depending on the herring's whim. And our contribution as scientists has been to develop echo-sounding so that a fisherman can know when his sounder is showing herring rather than when it is on something he does not want. To make up for the limitation of searching power, we have developed a method of plotting soundings on herring over a wide area, and can now recommend for the summer fishery, when supplies are sometimes below even the existing demand, that such surveys should be made.

Working for a New Era All these things, we are confident, help the existing situation, and will bring their full harvest when the metamorphosis of the dream is complete. And for most of the resources of the sea, especially for the overfished ones, we have worked for a new era. The overfishing of near-waters stocks of plaice and haddock and hake, the kind that the existing market favours, has had the same depressing effect on the population of fishermen as the dwindling of the herring fishery has : boys, on their profit-sharing system, not going when their fathers and uncles toiled for a pittance. Here, we have demonstrated that there is a profit to be obtained for the taking. We have estimated it at a 15 per cent increase in catch within a year or two of the fishing nations joining to take some of the pressure off these stocks—and, incidentally, if they care to do it that way, taking some of the pressure off the fishermen too—and allowing the fish to grow : to kill the fish as beef instead of as veal.

Slowly, it is true, we are arriving at this. The Overfishing Convention, agreed (on the British initiative I may mention) in 1946, was at last ratified by all parties early this year, and on April 5, 1954 twelve nations will put into force the mesh regulations and size limits that form the first essential step in progress towards taking that 15 per cent. This, I would claim, is in keeping with the "dream" as it should be and will be. We use our science to learn how to work with nature, not against her, and with the best in human nature, so that the wealth of twentieth-century technology may become available. Fishery problems show neatly how the twentieth-century dream may come true : through operational research into sociology to match the advance of technology. In this, as in greater matters, we can only hope to survive if, with full understanding, we meet human needs in the pattern of nature.

DOES IT PAY TO FEED CONCENTRATES TO DAIRY COWS ?

MICHAEL B. JAWETZ, B.Com.

Department of Agricultural Economics, University College of Wales, Aberystwyth

SOME farmers doubt whether, at present prices, it pays to feed expensive purchased concentrates to average commercial cows. It is sometimes held that a low-yielding herd fed mainly on cheap, home-grown, bulky foods may be a better paying proposition than a higher-yielding herd fed on large quantities of purchased concentrates. In this article, the evidence on this point is examined and the conclusion is that, in general, where the herd is capable of giving a higher yield in response to better management and increased feeding, the additional yield will more than repay the farmer for the higher total food costs.

Analysis of the results of the National Milk Cost Investigation for 1951–52 has not yet been completed, but data for 1950–51 throw a useful light on the subject. It is probable that in that year profits per cow were slightly higher than in 1951–52 ; nevertheless, the general relationship between yield and costs and profits prevailing in 1950–51 is still valid. They are shown in Table 1 for 60 herds in Wales and 138 herds in the west of England.

The total cost of concentrates increased at a greater rate than yields and total returns—a good example of the law of diminishing returns. As against this, costs of " bulky foods and grazing " and " other costs " increased at a distinctly lower rate. The net result was that profit per cow rose continuously with increasing yield, i.e., the higher the yield the higher the profit.

Looking for reasons for the higher yields, it is soon clear that they cannot be attributed to any large extent to feeding more bulky foods and grazing. The main reasons are almost certainly better management and increased feeding of concentrates. We cannot measure here the influence of management, but the table shows very clearly the relationship between the quantities of concentrates fed and the average yield. The increased expenditure on concentrates was accompanied by proportionately smaller increases in other costs, of which a large proportion represents maintenance and overhead costs.

As profit per cow rose more sharply than yields, and since yields are partly dependent upon the quantity of concentrates fed, it follows that, on average, under the economic conditions prevailing in 1950–51, it paid to feed concentrates at any level of yield represented in Table 1.

The yield of a herd and the profit per cow is influenced by other important factors, such as the yielding capacity of the cows, their food conversion efficiency, the farmer's skill as a cowman, grassland manager and crop producer—even his bargaining powers or luck—as well as by soil and climate, availability of capital and credit and, at least in the short run, size and type of buildings. However, they do not invalidate the conclusion reached above.

The Point of Maximum Profit So far, the problem has been a simple one : it appears that it pays to feed concentrates at any level of yield. It becomes complicated when the question is asked : at a given yield, how much does it pay to increase the average herd yield per cow by feeding more concentrates ? The economist has an answer to this question ; it pays to increase production, even at diminishing returns per

Table 1

Average Food Costs, Other Costs, and Profit per Cow in Herds Grouped on the Basis of Average Yields*

(Average figures for 60 herds in Wales and 138 West of England herds in 1950–51)

	Yield Groups (per cow)					
	Under 500 Gal.	500-600 Gal.	600-700 Gal.	700-800 Gal.	800-900 Gal.	Over 900 Gal.
Average yield per cow (gallons)	450	539	652	755	841	1,058
Quantities of Concentrates Fed	*cwt.*	*cwt.*	*cwt.*	*cwt.*	*cwt.*	*cwt.*
Purchased	7.2	8.6	13.3	16.0	17.8	27.4
Home-grown	2.3	3.1	4.5	5.4	4.0	7.5
Total	**9.5**	**11.7**	**17.8**	**21.4**	**21.8**	**34.9**
Costs	£	£	£	£	£	£
Purchased foods	13.2	14.4	21.0	23.1	28.8	44.4
Home-grown concentrates† ..	1.7	2.3	2.4	4.1	3.0	5.6
Total concentrates ..	**14.9**	**16.7**	**24.4**	**27.2**	**31.8**	**50.0**
Bulky foods and grazing ..	14.4	15.3	18.8	18.6	20.9	19.6
Total food costs ..	**29.3**	**32.0**	**43.2**	**45.8**	**52.7**	**69.6**
Total other costs (*net*) ..	**21.8**	**23.3**	**24.0**	**25.6**	**30.2**	**36.6**
Total farm costs (*net*) ..	**51.1**	**55.3**	**67.2**	**71.4**	**82.9**	**106.2**
Returns	64.9	77.7	95.6	110.7	122.3	153.9
Profit	13.8	22.4	28.4	39.3	39.4	46.7

* Compiled from the following publications : † Estimated

J. R. E. Phillips. *General Report on the Costs of Milk Production for 60 Herds during* 1950-51. Department of Agricultural Economics, University College of Wales.

Teresa M. Beynon. *Report on Milk Production Costs*, 1950-51. Department of Economics (Agricultural Economics), University of Bristol.

General Report on the Investigation into the Economics of Milk Production in Cornwall, Devon and Dorset, 1950-51. Department of Economics (Agricultural Economics), University of Bristol.

additional unit of feed, up to the point when the cost of producing the additional gallon equals its value. At this point, total profit is at its maximum. Now, in this country the value of any quantity of milk is known at any time. The question is, therefore, what additional quantity of concentrates is necessary to obtain this additional yield of known value ? More precisely, when does it pay a farmer to increase his herd's average yield per cow by feeding more concentrates, and should he aim at raising it by, say, 20, 40 or 60 more gallons per cow ?

If the law of diminishing returns did not operate within the range of feeding normally encountered in commercial dairy herds, the question would not arise. Unfortunately it does, although conventional feeding standards take no account of it. Further, the conventional standards appear to be based near to the point of greatest output of milk per unit of nutrients fed.

As Table 1 indicates, this point is not necessarily that of maximum economic efficiency. Research workers in this country (1) and the U.S.A. have shown that the nutrients required for the production of milk increase with increasing level of yield. The Americans (2) conducted a large-scale experiment for this purpose which lasted two years and yielded 392 records. Their work was not concerned with protein requirements. The writer of this article, investigating variations in winter feeding on a sample of 50 commercial West of England herds comprising 1,566 cows, found variations in the consumption of starch equivalent (S.E.) similar to those in the American experiments, and also measured inputs of protein equivalent (P.E.) at various levels of yield. In Table 2 average requirements of starch equivalent for the production of one gallon of milk are given at various yield levels. They have been calculated separately from the American experiment and from the West of England herds. The production requirements of protein equivalent have been based on the West of England herds.

Table 2

Quantities of Nutrients Required for the Production of One Gallon of Milk at Various Yield Levels, excluding Maintenance Ration

(Herd averages, not applicable to individual cows)

Yield Level per Cow		Nutrient Requirements per Gallon (3.7 per cent fat)		
		U.S.A. Experiment	50 West of England Herds	
Yearly	Daily	Starch Equivalent	Starch Equivalent	Protein Equivalent
gal.	*gal.*	*lb.*	*lb.*	*lb.*
450	1.5	2.3*	2.2	0.53
600	2.0	2.4*	2.4	0.56
750	2.5	2.7	2.8	0.61
800	2.7	2.8	3.1	0.63
850	2.8	3.1	3.2	0.65
900	3.0	3.6	3.5	0.68
1,000	3.3	4.2	4.5	0.72

* Not in experiment ; from projected curve.

It appears from Table 2 that production requirements of S.E. per gallon increase proportionately more than for P.E. as the yield rises. The reason for this has yet to be found, and the economic implication cannot be treated in a short article. The S.E. requirements are, on average, slightly lower than conventional requirements (2.5 lb. per gallon) up to yields of about 600 gallons, and considerably higher at yields over 750 gallons a year. At 1,000 gallons they are approximately twice as high per gallon as at 600 gallons. Protein requirements at 450 gallons appear to be 10 per cent lower than the conventional 0.6 lb. per gallon, and rise to 20 per cent above standard at yields of 1,000 gallons.

It must be emphasized that the above figures are not necessarily valid for individual cows, but only for herd averages per cow. Individual animals within a herd may be more (or less) efficient converters of food into milk, and their inborn yielding capacity may differ quite considerably. Nothing in this article should, of course, be taken to mean that heavier feeding will automatically result in a higher yield. The efficient farmer will adjust his feeding of individual cows according to his own observations. However,

individual variations in food conversion and productive capacity "cancel out" when herd averages are considered. It is also implicit in the above argument that efficiently run herds will have lower production requirements than those given in Table 2, and inefficiently run herds will have higher requirements.

Assessing Cost and Profits for a Given Increase In order to measure the economic effect of increasing average herd yield, it is assumed here that at a medium and medium-high level of yield the average yield per cow can be increased by 30 or 60 gallons a year by feeding more concentrates. It is further assumed that this can best be done during the first six months of lactation, by monthly increments per cow of 5 or 10 gallons respectively over given yields. Table 3 shows how much balanced dairy cake per gallon would be necessary to increase production by 5 or 10 gallons monthly per cow in herds averaging 45, 60 and 75 gallons respectively per cow per month, and the cost of the additional cake at £37 per ton (equal to 4d. per lb.).

Table 3

Quantity and Cost of Balanced Dairy Cake, and Other Costs, for Each Additional Gallon at Different Yield Levels

To Raise Average Monthly Yield per cow		Balanced Dairy Cake Required per Additional Gallon	Cost of Dairy Cake	Other Costs	Total Cost
From	To		For Additional 5 Gallons		
gal.	*gal.*	*lb.*	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*
45	50	4.2	0 7 2	0 0 4	0 7 6
60	65	5.8	0 9 10	0 0 10	0 10 8
75	80	6.9	0 11 9	0 1 6	0 13 3
			For Additional 10 Gallons		
			£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*
45	55	4.3	0 14 8	0 1 0	0 15 8
60	70	6.1	1 0 9	0 2 7	1 3 4
75	85	8.3	1 8 3	0 4 2	1 12 5

The requirements of dairy cake per additional gallon of milk have been calculated on the figures given in Table 2. The figures in Table 3 represent averages of three separate results, two for S.E. and one for P.E., obtained from each level of yield.

The additional balanced dairy cake required to step up production at a low yield level is practically equal to that necessary per gallon according to conventional standard requirements. At medium yields they appear to be about 40 per cent above standard. At higher yields they are 65 per cent above the usually recommended standard for small increases in yield (5 gallons a month) and about twice as high as standard requirements for slightly greater increases (10 gallons a month).

The term "other costs" in Table 3 represents charges for additional labour spent on milking and feeding the additional concentrates, and slight increases of such costs as dairy equipment, veterinary fees, consumable dairy stores and general expenses that would probably occur in the long run. These additional costs are small and not in proportion to additional yields. Fixed costs on milk production are ignored in calculations of additional

costs, as they are incurred anyway. The last column of Table 3 shows the additional costs for the extra milk production.

Returns for the additional milk at average quarterly pool prices are set out in Table 4, together with the profit per cow at the three production levels discussed.

Table 4

Effect of Raising Milk Yield as Profit (or Loss) per Cow

Returns for Milk at Average Quarterly Pool Prices	Average Monthly Additional Profit (or Loss) per Cow		
	For Additional 5 Gallons	For 5 Gallons Additional Production	
		From 45 to 50 Gallons	From 60 to 65 Gallons	From 75 to 80 Gallons
1952	£ s. d.	£ s. d.	£ s. d.	£ s. d.
April-June	0 11 0	0 3 6	0 0 4	-0 2 3
July-September ..	0 13 0	0 5 6	0 2 4	-0 0 3
October-December	0 18 0	0 10 6	0 7 4	0 4 9
1953				
January-March ..	0 17 0	0 9 6	0 6 4	0 3 9
	For Additional 10 Gallons	For 10 Gallons Additional Production		
		From 45 to 55 Gallons	From 60 to 70 Gallons	From 75 to 85 Gallons
1952	£ s. d.	£ s. d.	£ s. d.	£ s. d.
April-June ..	1 2 0	0 6 4	-0 1 4	-0 10 5
July-September ..	1 7 3	0 11 7	0 3 11	-0 5 2
October-December	1 15 11	1 0 3	0 12 7	0 3 6
1953				
January-March ..	1 14 1	0 18 5	0 10 9	0 1 8

A Worthwhile Practice Table 4 shows that last summer it would have paid a farmer with a herd with a low average yield to feed more concentrates and so increase its yield. It would have been doubly profitable to have done so in the past winter. The figures suggest that even at the increased yield levels, production would not be anywhere near the economic optimum, and that it would pay to feed more dairy cake and raise yields still further.

At medium yields, increasing monthly production by 5 gallons per cow would have paid a little in the summer. An additional 10 gallons would have involved a small loss at pool prices prevailing in the spring quarter, but would still have paid in the summer quarter. This winter increase of 10 gallons per cow would pay handsomely enough to imply that an even greater addition of dairy cake would be economic.

In high-yielding herds it would not have paid to have fed more concentrates during the summer. It should, however, still have been profitable to have done so in the winter. At all yield levels, profits in T.T. herds would, naturally, be higher.

The total extra profit from increased yields of 30 and 60 gallons respectively are presented in Table 5 at average summer and winter pool prices, and with T.T. premium added. The results are given per cow and for a herd of 20 cows, at which point the economic effect of additional quantities of expensive concentrates is better illustrated.

Table 5

Total Additional Profit (or Loss) from Six Months' Additional Production

(at yield levels as in Table 3)

Additional Milk Production in Six Months		Total Additional Profit (or Loss) from Higher Yield					
		At Low Yields		At Medium Yields		At High Yields	
Total	Period	Ordinary Milk	T.T. Milk	Ordinary Milk	T.T. Milk	Ordinary Milk	T.T. Milk
gal.		Per Cow					
		£ *s. d.*	£ *s. d.*	£ *s. d.*	£ *s. d.*	£ *s. d.*	£ *s. d.*
30	Summer (Apr.-Sept)	1 7 0	1 17 0	0 6 0	16 0	–0 6 0	0 4 0
	Winter (Oct.-Mar.)	3 0 0	3 10 0	2 1 0	2 11 0	1 5 0	1 15 0
60	Summer	2 14 0	3 4 0	0 8 0	1 8 0	–2 7 0	–1 7 0
	Winter	5 16 0	6 6 0	3 10 0	4 10 0	0 15 0	1 15 0
		Per Herd of 20 Cows					
		£	£	£	£	£	£
600	Summer	27	37	6	16	–6	4
	Winter	60	70	41	51	25	35
1,200	Summer	54	74	8	28	–47	–27
	Winter	116	136	70	90	15	35

The conclusion to be drawn from Table 5 is that at 1952-3 costs of balanced dairy cakes and prices of milk, it pays very well indeed to feed more dairy cake to herds with low and moderate yields, so as to increase yearly production by up to 60 gallons per cow from spring calvers, and well over 60 gallons from autumn calvers. For higher-yielding herds, the process would not pay in the summer but would still be profitable in winter, particularly for T.T. herds.

The above discussion does not touch upon the possibility of substituting cheaper home-grown foods or grazing in place of expensive purchased concentrates. Only balanced dairy cake, one of the most expensive sources of nutrients, has been considered. It is obvious that if it pays to obtain higher yields by feeding more of the most expensive cattle foods, then their substitution by cheaper feedingstuffs would result in even higher profits, or turn a small loss into a profit.

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GENETICS AND THE POULTRY-KEEPER

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In formulating what he thinks will be his best mating system, the poultry-breeder looks to the geneticist for guidance. Dr. Blyth discusses here some of the complex problems that lie behind such advice.

IN face of the constant demand for better breeding methods and more reliable rules for the improvement of economic qualities in livestock, there must sometimes be a feeling that genetics lags behind other sciences in providing assistance for the poultryman. Nutrition experiments, for example, are often immediately applicable in the field, but it has to be remembered that they have started off from the stable basis supplied by the immense amount of research in pure chemistry that has gone before. Genetics, on the other hand, is a relatively new science, still in its formative stage, with the full implications of even its basic theory—the theory of Mendel—not yet completely understood. Behind the scenes, however, something of a revolution has been going on. In recent years genetics has become a kind of key subject, and its students are gradually making use of one after another of the other sciences in their efforts to elucidate further the mechanism of heredity. An attack from so many sides cannot but prove fertile of results but, in the main, these are yet to come.

Meantime, the practical man wants to know what the geneticist has to offer now. As already suggested, the facts the latter has at his command are not as many as he might like and so, in most cases, he would be unwise to put his advice in the form of cut and dried rules. But he has arrived at many ideas which may provide the poultry-keeper with fresh aspects from which to look at his breeding programme when decisions have to be made about it.

Heredity and Environment Perhaps the most difficult idea of all to grasp in genetics, and the one most frequently misunderstood, is that of the relationship between heredity and environment. So-called hereditary characters are not inherited. It is the genes which are the real hereditary units ; they are borne on the chromosomes of the cells, and passed on in the egg and sperm to each new individual. Again, to say that genes give rise to characters is also something of a half truth, for the final form which the character takes depends on the interaction of the effect of the gene with the effect of the environment in which it finds itself acting.

If we try to consider simple characters like comb and plumage types in relation to this dual background, the participation of environment is not usually obvious because these traits have much the same expression over the normal range of environments in which they are developed. Thus though comb size increases when birds are kept in the dark the change is never likely to lead to a confusion between the effects of the genes for rose comb and for single comb. One gene, of course, might be regarded as part of the environment of another ; in that case, it is easy to think of the gene for black plumage as having no expression at all in the presence of the gene for the dominant white of the White Leghorn. This type of effect though—of one gene on the action of another—is more conveniently described in other ways, and the term "environment" is reserved for agencies acting from outside the reproductive cell, and generally outside the bird itself. Climate, food and management are such factors, but they can act very differently on individual birds because of a host of minor, usually unnoticed, differences, such as the

draughtiness of a bird's favourite perch, or the time the hen happens to go to the nest in relation to feeding hours.

It is when we are dealing with economic traits that the conception of the character resulting from the interplay of gene and environment becomes so important. Production traits are usually based on many genes, but the principle is the same. To take an imaginary case, a group of birds might be laying equally well until a cold snap supervened, whereupon they would show varying ability to maintain production ; the second environment might be said to have brought out genetic differences which were not in evidence under the first. Another, and good, example of this actually arose in some work carried out recently at the Poultry Research Centre on sexual maturity : groups of early-hatched pullets from several sires showed differences in the average age at which laying began, and these were regarded as genetic in origin. Birds hatched later in the season from the same sires also showed differences, but not all in the same direction, so that males whose offspring ranked earliest in the first case came further down the scale in the second. Apparently the environment prevailing when the earlier-hatched pullets were nearing maturity suited some sire families better than others ; the same applied for later-hatched groups, but not for pullets from the same sires. Incidentally, it appeared that, besides natural agencies, extra lighting affected the order in which the sire groups matured.

These illustrations serve to emphasize two basic conditions affecting most production characters : (1) the same genotype (that is the collection of genes that goes to produce an individual, or trait) may yield different results in different environments ; and (2) different genotypes may produce the same result in a particular environment. In the second case, it is immaterial which of the genotypes is present as long as the environment is right. In the first, things are less simple, and the question arises whether it is better to try to fit the bird to the environment or vice versa ; or if indeed the choice is open. Traits, like egg production, must normally be expressed in an ever-changing series of climatic conditions, and it is possible that the breeding of one bird may make it better adapted to give its best in one season, while that of a second may be more suited to another season. One inference to be drawn from this is that breeding stock should be selected on their performance under conditions which are generally similar to those under which their progeny are to be maintained.

It might be argued further that genetical research should be carried out under conditions comparable with those on the farm. But this would not always be desirable. Thus in the case of egg production, we have really very little certain information of the extent to which external seasonal changes affect it, and to attempt to gain more by trying to directly correlate changes in production with the detailed vagaries of our climate, would be a well-nigh hopeless task. Such problems are better tackled by studying the course of laying when environmental variations are cut down to a minimum. Dr. Alan Greenwood has an experiment of this kind under way here now, in which a group of birds has been divided between a room in which temperature and lighting are kept constant, and a pen in the general poultry-house.

Complex Traits Genes, it may be recalled, occur in a series of pairs in the cells. Members of a pair may be alike in action (homozygous and true breeding), or they may have different effects (heterozygous), in which case one gene is said to be " the allele " of the other ; they occupy the same positions on the homologous chromosomes which carry them. One gene of a pair is received from each parent, and only one can be passed

on to each offspring, but the half-set of genes so passed on by a bird can contain any proportion of its own maternal and paternal genes. The chances, however, that an individual should receive a complete half-set of one grandparent's genes are practically negligible ; it is much more likely that something nearer a quarter of its inheritance comes from each of its four ancestors in that generation.

Economic traits depend on many genes, and since certain minimum standards of functioning in most organs of the body are usually necessary for their expression, they can be considered as being affected by some genes directly and by others indirectly. The phenotype (that is, the trait as it is actually expressed) is a sort of average result of the interplay of these many genes with environment, and it is manifestly impossible to analyse the part which each gene plays, though it is often practicable to consider smaller units than the whole genotype. Genetic differences in traits between birds therefore become average differences between groups of genes, but the alterations they make to the phenotype are mixed up with those caused by environment. Thus one bird may be showing a trait in a form rather better than the average of its possible range of expressions, and another considerably worse.

Though it is not possible to follow this kind of hereditary quota from one individual to another, the laws of Mendel still hold, and statistically-minded workers have been able to show that for particular types of matings in a closed flock, certain consequences must follow. Thus in a flock maintained so that all genetic types have an equal chance of inter-mating with one another (random mating), the gene frequency, which is the proportion of any particular gene in the flock relative to its contrasting allele, does not change from generation to generation. If a sufficiently large group of genetically-superior birds is selected from the flock and again inter-mated, the genes will, after a preliminary shuffling around for a generation or so, settle down in equilibrium with a new higher frequency of desirable ones. Again, if all the individuals of a closed group were systematically inbred, the gene frequency over the whole flock would not alter, but it would change in its component lines. Within each line the frequency of a gene would increase and that of its allele diminish, so that some lines become pure for one and some for the other. The process goes on for each pair of alleles but independently, so that though several lines may become alike for any particular gene, they will differ in many others that go to make up the genotypes in them. Only within lines is there an increase in the portion of the whole gene set that is alike in different individuals.

Measuring Heritability The use to which the consequences of these and other mating systems can be put depends on the degree of accuracy with which birds having superior genotypes can be recognized. For most traits of economic value, the breeder knows this is difficult to decide, but the geneticist must know in concrete terms *how* difficult. Otherwise, he has no yardstick to measure the worth of any new techniques he may devise. The best criterion arrived at so far is the statistic "heritability" ; it measures the fraction of the total variation between individuals traceable to genetic differences between them. It can give no information about the difference between any two particular birds, only an estimate for the flock as a whole. It has some peculiarities which have to be kept in mind : any wide differences due to environment among birds would make the total variation greater, and so make the portion due to genotypes appear less ; similarly, a very uniform environment might make the portion due to genotypes seem greater.

Differences in the heritability of a trait in two flocks, therefore, would have little meaning unless the conditions under which they were kept were reasonably alike. Again, because of their greater common inheritance, relatives, like full sisters or single sire progenies, are more akin than the general run of the flock, and therefore show less genetic variation among themselves. The extent of the reduction can actually be calculated for particular degrees of relationship. Thus when geneticists give a figure for the heritability of a trait, they adopt the convention of computing the value of it which would be expected in a flock under random mating. Care is also usually taken to collect the data used for it under what are judged to be average conditions of environment, though there is still some difference of opinion as to what that really means.

In complex traits heritability measures mainly the additive variability, that is the variation depending on genes which have the effect of adding or subtracting small units from the total value of the genotype in a straightforward way. It cannot give a true account of the situation where much dominance is present and the genes disguise the effects of one another. The proportion of such genes, however, appears to be small in closed flocks under ordinary conditions of mating, though they have their uses elsewhere.

Using our Knowledge of Heritability Knowing the heritability of traits helps to decide the best method of selecting breeding stock. With traits of high heritability (egg weight and body size are among them), the best results are obtained by selecting the individual on its own phenotype. With traits of low heritability (such as egg production and viability) it is better to select top individuals of families which have given the best average performance in preference to outstanding birds from poor families. This is because full sisters have more of the same genes in common than unrelated birds, and their average behaviour is a better guide than that of any one of them alone, when genetic effects are very difficult to distinguish. For the same reason, full sisters can be used to judge the ranking of males for traits they themselves cannot express.

There is another use to which estimates of heritability can be put. Some of the genes behind one desirable character may be the opposite of those required for another, and selection for the first might therefore have an adverse effect on the second. This probably happens to some extent between egg numbers and egg weight. Or again, two desirable traits may have a proportion of their genes in common, in which case selection for one would tend to improve the other.

While breeders are no doubt aware of several such combinations, there must be many more combinations where the exact situation is obscured by environmental variation, and it would be of considerable advantage to the industry if they could be cleared up. This involves the rather tricky business of computing genetic correlations between traits, or component parts of them. When it is done, and knowing their heritability, it is possible even to juggle with negatively related traits to find the relative amount of attention which should be given to each to obtain the greatest progress. This results in *selection indexes*. These are calculated for each bird by multiplying the value of every trait considered by the fraction found appropriate to it. The sum of these weighted figures then gives the ranking of the bird in the flock.

The use of detailed indexes of this sort could never be expected to pay its way on the ordinary farm, but they and the genetic relations behind them appear well worth working out. Apart from the reliable information this would supply in a general way, it would provide experts with the means of

devising simple indexes to suit special cases, or enable them to pick out with more certainty any weaknesses in breeding programmes they might be required to vet.

Hybrid Vigour It was mentioned earlier that non-additive genes also have their uses. They appear to be the ones mostly concerned in hybrid vigour. The best recognized forms taken by non-additiveness are : *dominance*, where one gene suppresses the effect of its allele ; *epistasis*, in which the same thing occurs but the suppressed gene is not the allele of the overruling one ; and *overdominance*, where the presence of two contrasting alleles in the same individual gives a more desirable effect than when either of them is present in the pure form. In highly improved, closed flocks where some of the additive variation has been eliminated, non-additive differences become more important.

Two possible reasons for hybrid vigour have been put forward ; one, that birds from different strains or breeds, are likely to have different sets of pure-breeding dominants in their genotypes. As dominants usually give desirable characters, when a cross is made the effect of both sets of dominants are added to those of additive genes to produce something better than usual in the expression of the genotype. The other explanation, that overdominance is involved in these heightened effects, seems to have been established for certain plants, but how much importance it has in animal crosses is not yet known. On these theories, the right differences must be present between groups to be crossed if heterotic (hybrid vigour) effects are to be obtained. This is in line with our knowledge that some crosses do better than others, while some show no extra improvement at all.

Breeding schemes, designed to get the most out of non-additive genes, have all been modelled on those found most satisfactory in grain research where the material used permits far more experimental results in a given time than can be done with animals. Modifications, of course, have been necessary in the techniques to allow for the differences in the reproductive processes between plants and birds.

The first to be exploited with poultry was the development of inbred lines. This necessitates the building up of a large number of lines and cross-mating them to find which will nick best, or in other words, which will have the most satisfactory sets of complementary dominants in terms of the first theory. Since, in rapid inbreeding practically nothing can be done to select which alleles are kept and which eliminated, the lines so made are often poor reproducers, and it may require three-way or four-way crosses to produce chicks on a commercial scale by this method. Again, the genotypes in highly inbred lines are apt to be delicately balanced so that the accidental loss of some single gene from one may have disastrous effects there although it would pass unnoticed in an ordinary flock. Thus though inbred lines are extremely valuable for research at institutes such as this, as at present constructed they have some definite shortcomings in actual breeding practice.

Recent Breeding Techniques Another technique developed (*Recurrent Selection for Specific Combining Ability*) calls for the use of one good inbred line already established. Both males and females of an open-bred flock are crossed with the inbred line and the parents from the latter group are selected, on the performance of their cross progeny, to supply breeders to carry on the pure flock, cross- and pure-generations being raised alternately. The inbred line, called the tester line, can be regarded as a lock to which a key (non-additive genes) is gradually being moulded in

the open flock. The success of this project again rests on the ability to keep the tester line in a satisfactory condition. If anything goes wrong with it, the whole scheme collapses, for a flock adapted to one inbred line will not necessarily nick with another.

The latest and most hopeful method advocated (*Recurrent Reciprocal Selection*) is to carry out the same process with two open-bred flocks instead of using an inbred line, so that both are gradually being adapted towards providing the best combining ability between them.

As to practical details, these last two techniques can be carried out with different breeds, or strains within a breed. Only stocks that have shown evidence of hybrid vigour in a trial cross should be used. Highly heritable characters like egg weight and body weight can be selected for direct in the pure groups, while decisions about the more difficult ones of egg production and viability are based on the performance of the cross progenies. In recurrent selection, since only one side of the cross is being selected, progenies of tested sires need only be pedigreed by sires, and those of tested dams, by dams. A reasonably large number of crosses require to be raised if progress is to be expected. Thus if 5 males are required to reproduce an open-bred flock, at least 20–25 should be given cross-mating tests. This not only gives a choice, but also a chance of retaining cocks that are not all closely related. Use of the latter would lead to inbreeding and a reduction in variability before all that variation had been fairly tested out to show its usefulness or otherwise in combination with that of the other group. But for this consideration, the open-bred flocks could be reproduced unpedigreed by flock matings.

The question of what is the best mating system to use must remain a matter for the breeder himself ; the geneticist can only tell him what he considers to be their relative merits and disadvantages. One final point may be made : it used to be assumed that the aim of the breeder was the ideal bird. It is now becoming clear that the ideal bird for one set of conditions may have shortcomings in another, and that variability, once lost, cannot be recovered without greatly changing the genotype by crossing. It seems sound practice, therefore, not to aim at too complete a fixity of type, and to keep a little variability in a flock for emergencies. Fashions change in the poultry industry as elsewhere.

How Much Food Can We Grow at Home ?

The Government's food production drive aims at not less than 60 per cent more over pre-war by 1956.

A note on the Torquay Conference appears on page 92.

DELAYED BLOOMING OF MIDSEASON AND LATE-FLOWERING CHRYSANTHEMUMS

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Trials at Reading show that by extending the period of daylight artificially, certain varieties can be timed for the Christmas market.

IT has been known for some considerable time that the chrysanthemum is a short-day plant, initiating flowers only when the days become shorter than about 14½ hours. This knowledge has been used by market growers in the U.S.A. to manipulate the timing of the crop, either to delay the blooming date by artificially extending the short autumn and winter days, or to hasten the flowering by shading the plants with black cloth and so shortening the long summer days. The timing of the crop by these methods has been worked out in considerable detail for American varieties and conditions, and by shortening and lengthening the day artificially chrysanthemums may be had in flower at any season of the year. Particular value is placed on timing the crop for a specific market, and today many growers make considerable use of manipulation of day length to produce their chrysanthemum crop by a certain date.

The possibility of applying this method of chrysanthemum production in this country has been considered. In general, it would seem that no advantage would accrue from hastening the blooming of midseason or early-flowering varieties, since it is probable that no real market for chrysanthemums would exist through the summer. On the other hand, the use of long days to delay the blooming of certain midseason and late-flowering decoratives is of considerable interest, particularly if this can be done to time the crop for the Christmas market. Further delay into the New Year may also be valuable, especially if good quality blooms can be produced by this method. The flowering date of a single variety may be extended over several weeks ; this would be a useful procedure where one variety was particularly successful on a nursery. Manipulation of day length to effect blooming for a specific date may also be of considerable value to the chrysanthemum specialist who wishes to exhibit at out-of-season shows.

Preliminary trials on the delaying of flowering have been carried out with some English varieties to establish a satisfactory method of applying the artificial lighting, to calculate the economic returns which might be expected from the practice, to determine dates for beginning and stopping the treatment, and to find the best varieties to use under these conditions.

Cost of Equipment The supplementary irradiation was given on the standing ground and discontinued when the plants were housed. The experimental installation consisted of eight rows of lights, each 50 feet long and spaced 3 feet apart ; the cable (7/.029 T.R.S.) was supported at intervals of 14–16 feet by posts 7 feet high, and was suspended at a height of approximately 6 feet above ground level. The lamp-holders were spaced at intervals of 4 feet on the cable, and 40-watt incandescent lamps were used without reflectors.

The estimated capital cost of a similar, but slightly larger, installation is as follows :

		£	s.	d.
Materials	350 yards 7/.029 T.R.S. cable	35	0	0
	250 lamp-holders	21	17	6
	106 40-watt lamps	17	3	9
	1 10-way distribution board	1	15	0
	1 60-amp switch fuse		18	6
	1 60-amp time-switch	10	10	0
	Sundry materials	1	10	0
		88	14	9
Labour		25	0	0
		113	14	9

This estimate assumes that suitable supports are available, and that a weatherproof chamber for housing switchgear is provided.

The installation would provide two hundred and fifty 40-watt lamps spaced at 4-foot intervals, supplying light over five 200-feet rows. This would light (a) 1,000 plants pot-thick in single rows directly under the lights, or (b) 1,330 plants in double rows 18 inches apart, with the plants 18 inches apart in the row, and the lights over the centre of the double row. Allowing for 10 per cent depreciation, the annual cost per plant under system (a) would be about 2.8d., and for system (b) about 2.1d. The annual cost of electricity will depend on the duration of irradiation, and is calculated separately in the several experiments. It would not amount to more than 1d. per plant, and would usually be not more than ½d. The total cost (electricity plus depreciation) per plant, therefore, is not more than 3.8d., and may be less than 2.6d.

The First Experiment The first experiment (in 1949) was in the nature of a preliminary trial of fourteen varieties. The plants were raised in the usual manner from February cuttings, and grown with the main batch of plants until the lighting treatment was applied. To ensure that the plants were completely vegetative at the beginning of the lighting period in this preliminary trial, the lighting was begun on July 19, when the day length (sunrise to sunset) is 16 hours. Three treatments were given : (1) control batch—not lighted ; (2) supplementary lighting beginning 30 minutes after sunset, to give a total day length of 17 hours calculated from 30 minutes before sunrise (the time switch was adjusted weekly) ; (3) interrupted night—lighted for two hours nightly from midnight to 2 a.m. The lighting ceased on September 7, when the plants were housed.

It has been established for photoperiodic plants that a brief interruption during the long dark period is equivalent to a long day, and it was considered that a routine 2-hour lighting period controlled by a time switch is easier in practice than a weekly adjustment of the time switch to give a 17-hour day. The minimum nightly duration of lighting is dependent on the intensity of the illumination, and a shorter period is effective at higher intensities. Two hours per night may not be the minimum practicable at the intensities used, and the question of the nightly duration of irradiation remains to be investigated.

The blooms were duly cut and marketed, and records were kept of the date of cutting and the total number of blooms cut in each treatment. Table 1 shows the number of weeks' delay in the cutting of the treated plants compared with the controls.

Table 1

Delay in Flowering (1949)

Variety	Mean Delay over Control	
	Broken Night	Extended Day
	weeks	*weeks*
American Beauty	1.6	1.9
Baldock's Crimson	2.1	2.1
Crensa	0.6	1.6
Friendly Rival	3.8	3.2
Golden Seal	1.6	1.6
Imperial Pink	2.0	2.1
Late Delight	1.3	2.0
Loveliness	1.1	0.8
Margaret Vinten	0.8	2.0
Market Gold	1.5	0.8
Magnet	2.9	2.6
Mollie Nicolson	1.7	1.3
Sussex Bronze	2.1	2.7
Yellow Paine	2.0	1.8

It will be seen from the above table that the delay in blooming was from one to three weeks, and consequently only the later blooming varieties received the benefit of the increased price of the Christmas market. Table 2 shows the receipts for each treatment as a percentage of the control, after subtracting the cost of electricity and depreciation of equipment at 10 per cent, for (a) single-row, and (b) double-row spacing. The receipts in all the experiments are calculated from the weekly average market price obtained for each variety by the University Horticultural Station.

Table 2

Receipts expressed as a Percentage of Controls (1949)

Variety	Single Row		Double Row	
	Broken Night	Extended Day	Broken Night	Extended Day
	per cent	*per cent*	*per cent*	*per cent*
American Beauty	112	87	113	88
Baldock's Crimson	77	64	80	77
Crensa	76	71	77	75
Friendly Rival	113	101	115	103
Golden Seal	65	58	67	60
Imperial Pink	136	138	138	141
Late Delight	101	137	103	139
Loveliness	65	76	66	78
Margaret Vinten	118	101	122	107
Market Gold	64	74	66	76
Magnet	87	77	91	80
Mollie Nicolson	115	112	118	115
Sussex Bronze	65	73	66	75
Yellow Paine	112	110	114	112

Trials in 1950 On the basis of the experience in the first experiment, the varieties *Friendly Rival*, *American Beauty*, *Crensa*, *Yellow Paine*, and *Magnet* were selected for trial in 1950. Since the use of the "broken-night" method of supplying supplementary light had been found

to give a satisfactory result in 1949 and to be easier in practice, this method was used for both lighting treatments in 1950. Three treatments were given :

A. Lighted 11 p.m.—1 a.m., July 19—September 5.
B. Lighted 1.15 a.m.—3.15 a.m., August 5—September 5.
C. Unlighted.

Two lighting treatments only were possible at this time and, consequently, the effect of delaying the start of the lighting treatment by two weeks was studied.

The date of flowering was considerably delayed (Table 3) but in many of the varieties the delay was so great that few blooms had been cut at the end of the experiment on March 8, 1951. In many cases, the buds had formed and were not yet open (especially in *American Beauty*), while in others the buds had failed to form or had aborted. This may have been due to the excessively wet growing season, or to too low a temperature.

Table 3
Delay in Flowering (1950)

Variety	Mean Delay over Control	
	Treatment A	Treatment B
	weeks	*weeks*
American Beauty	4+	3.7
Crensa	7.7	5.0
Friendly Rival	5.2	5.6
Magnet	4.2	5.3
Yellow Paine	3.5	4.7

Treatment A did not differ significantly from Treatment B, and for all varieties the number of blooms cut was considerably less in A and B than in the untreated plants. The results suggest that in a year such as 1950, when all blooms are much later than normal, extending the day length may delay the cut until after Christmas. In such an exceptional year the grower would have to use his experience of the state of development of the crop and discontinue the lighting treatment earlier.

The Third Year Two varieties only were used in this experiment : *Friendly Rival* as a standard late-flowering decorative normally flowering about the first week in December, and *Crensa* as a standard mid-season decorative with a normal blooming date in early November. The following treatments were given :

1. Lighted August 2—30 (4 weeks).
2. Lighted August 2—September 13 (6 weeks).
3. Lighted August 16—September 13 (4 weeks).
4. Lighted August 16—30 (2 weeks).
5. Unlighted control.

All lighting treatments were given from midnight to 2 a.m.

The results given in Table 4 overleaf were recorded for the delay in flowering

of the lighted treatments over the control plants :

Table 4
Delay in Flowering (1951)

Variety	Mean Delay over Control			
	Treatment			
	4	1	3	2
	weeks	*weeks*	*weeks*	*weeks*
Friendly Rival ..	0.6	0.7	2.1	2.2
Crensa	0.3	0.4	1.3	1.6

Most of the flowers had been cut by Christmas ; the maximum cut for *Friendly Rival* (2 and 3) was recorded for the week ended December 22. Treatments 2 and 3, and 1 and 4 gave comparable delay in blooming, and there would seem to be little advantage in starting the lighting treatment before about August 16, especially in view of the added cost of the electricity. The timing adopted in this trial, i.e., discontinuing the lighting about September 13, proved satisfactory for *Friendly Rival* and would probably be applicable to other varieties blooming about the same time. With earlier flowering varieties, as typified in this experiment by *Crensa*, the development of the flower bud is more rapid and, to delay blooming still further and cut for the Christmas market, the lighting treatment would have to be continued longer. To grow the plants well under these conditions and to prevent blindness of the bud, which occurs if the flowering is delayed too long, later propagation and stopping would probably be necessary.

The receipts from sales after subtraction of the cost of electricity and depreciation, expressed as a percentage of the control for each treatment, are shown in Table 5.

Table 5
Receipts* expressed as a Percentage of Control (1951)

Variety	Single Row				Double Row			
	Treatment				Treatment			
	1	2	3	4	1	2	3	4
Friendly Rival ..	125	136	139	119	127	137	140	121
Crensa	96	119	116	93	98	120	118	95

* From 24 plants.

Although much work remains to be done on the responses of English varieties of chrysanthemum to supplementary irradiation, it is evident that it would be possible to manipulate the date of flowering of the majority of varieties by lighting treatments. There is probably no advantage to commercial practice in this country by advancing the flowering date of any variety, but delaying flowering by artificial lighting applied when the plants are on the standing ground has been shown to be a practical proposition for certain varieties. So far, only the later varieties have been delayed until Christmas, though by later propagation and stopping it should be possible to delay the earlier varieties until then, if required. There are, however,

practical difficulties. The maximum cut of *Crensa* in 1951 was recorded during the week ended December 1, when the lighting was discontinued on September 13. To delay cutting for a further three weeks, it would probably be necessary to continue lighting the plants at least until October 7, when the plants would normally be housed. Plants grown from late-struck cuttings and housed in August could be irradiated in the greenhouse until any desired date.

Summary Results with several varieties at Reading have shown that the application of supplementary irradiation to delay the blooming of late-flowering chrysanthemums is a practical proposition for the timing of certain varieties for the Christmas market. The varieties which have been most successfully treated are *Friendly Rival*, *Imperial Pink*, *Late Delight*, *Margaret Vinten*, *Mollie Nicolson* and *Yellow Paine*. So far, no midseason varieties have been delayed until the Christmas market. It is suggested that for varieties flowering normally between the end of November and early December, a four-week lighting treatment from about August 16 to September 13 should be effective in delaying flowering in the south of England until the third week in December. The use of lighting to delay the production of buds means that the plants can be housed and the flowers allowed to open under warmer conditions than would normally be applied if delay in blooming by lowering the temperature is attempted. This results in better quality flower production. The use of temperature control to regulate the speed of opening of the flowers can be superimposed on the lighting treatment. The temperature at which the plants are kept after housing is important, since at low temperatures buds will fail to develop even in short days. The house temperature should therefore be maintained at 50–60°F. until the buds are well developed.

THE POTTER

J. NOEL WHITE

Rural Industries Bureau

Who has not paused at some time to watch a potter at work, to marvel at the growth under his sensitive fingers of wares which blend that skill, imagination and utility which are common to so many of our ancient crafts ?

IN one respect the potter and the farmer are on common ground; they both earn their living by using with skill and science the same raw material —the earth. In their different ways they both have an intimate understanding of the earth's composition and behaviour. But unlike most farmers, the potter delights in wet, malleable clay which his sensitive fingers can fashion as it slowly spins upon his wheel. The process sounds simple : take a ball of clay, throw it on the wheel and, having formed the pot, fire it in the kiln. Yet it is one of the most skilled and complex of crafts. The clay which will form the body of the pot must be carefully chosen and prepared with other ingredients. It must also be of the right consistency, not only so that it can be shaped, but also become set hard and not collapse when fired.

Horticultural and Domestic Markets The demand for the products of the rural potter is still both wide and varied. Thus the grower often prefers the pots thrown by hand for growing seedlings because this method produces a pot with a high degree of porosity. Clay forced into a mould is not so permeable. The housewife, on the other hand, usually wants her pots watertight and suitably decorated. The body and the slip or brushwork must, therefore, be dipped in a chemical glaze which is fired so that the pot is covered with a hard protective skin like glass. Uncertain control of the firing produces a high proportion of faulty pots. For this reason few potters today can afford to use old and inefficient equipment which makes a job twice as long and uses twice as much fuel. To a country potter two lines of business, horticultural pots and domestic ware, offer as a rule a better prospect of steady orders than concentrating on glazed pottery.

The problems which face so many of those who earn their living in the country are crystallized in the potter, who must combine in his trade the traditional skill of the craftsman, the creative imagination of the artist and the modern science of the chemist, to say nothing of a good head for running a business. He must have, as the adage puts it, " something old and something new," and this is true of many rural occupations today. And by this combination most small country workshops offer something useful and often better than the factory, and something which, in the manner of its making, acquires the stamp of the artist, the useful plant pot, the decorative salt jar. The mixture of ancient and modern applies in equal measure to the implements or the decorative gates of the blacksmith, the trailers or the wagons of the wheelwright, the thatchers' roofs, the saddlers' harness, or the craft of the boatbuilder, but most obviously, perhaps, to the potter.

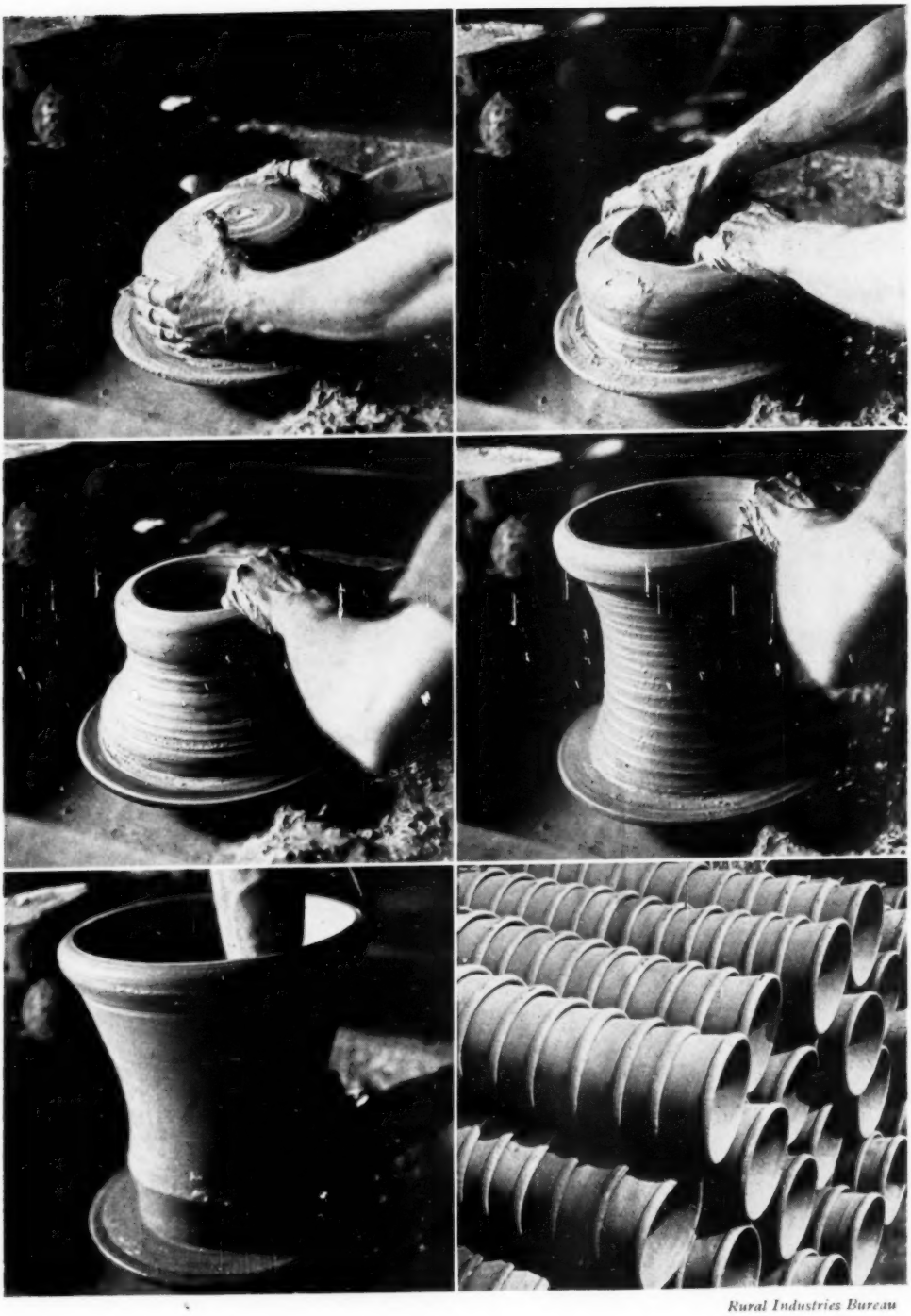
Economic Difficulties To many craftsmen, brought sternly face to face with the economic circumstances which harass us all, some degree of modernization has become a necessity. Yet to do so often requires more knowledge and capital than most countrymen can command—particularly since this seems a sabbatical century for fairy godmothers. Fortunately a craftsman living in a remote part of the countryside with perhaps slender financial resources, has some hope of coping with this dilemma, for in most counties there is a group of voluntary people who have the means of promoting rural development and welfare. They are usually known as a Rural Community Council, although some in various counties have chosen a different name. On behalf of any rural craftsmen they can seek the help of the Rural Industries Bureau, the national advisory service for rural craftsmen—akin to the N.A.A.S. for farmers—and also they can approach the Rural Industries Loan Fund, whose aim in its own sphere is similar to that of the Agricultural Mortgage Corporation, although it has a different constitution.

By these means the possibility of earning a living in the country, outside farming yet often ancillary to that father of all rural industries, becomes a reality. Without this means there would certainly be fewer rural potteries today using English clay.

So although a man may curse the clay which sticks to his spade or his boots, prevents his getting on the land half the winter, and sets like tar instead of tilth, it is well to remember the virtues of the many useful, and often handsome, things into which skilled hands can turn it.

Rural Industries Bureau

The potter demonstrates his art.



Rural Industries Bureau

A flower pot takes shape.

DELAYED BLOOMING OF CHRYSANTHEMUMS (See pp. 68-73)

Effects of supplementary irradiation on the variety *Friendly Rival*.

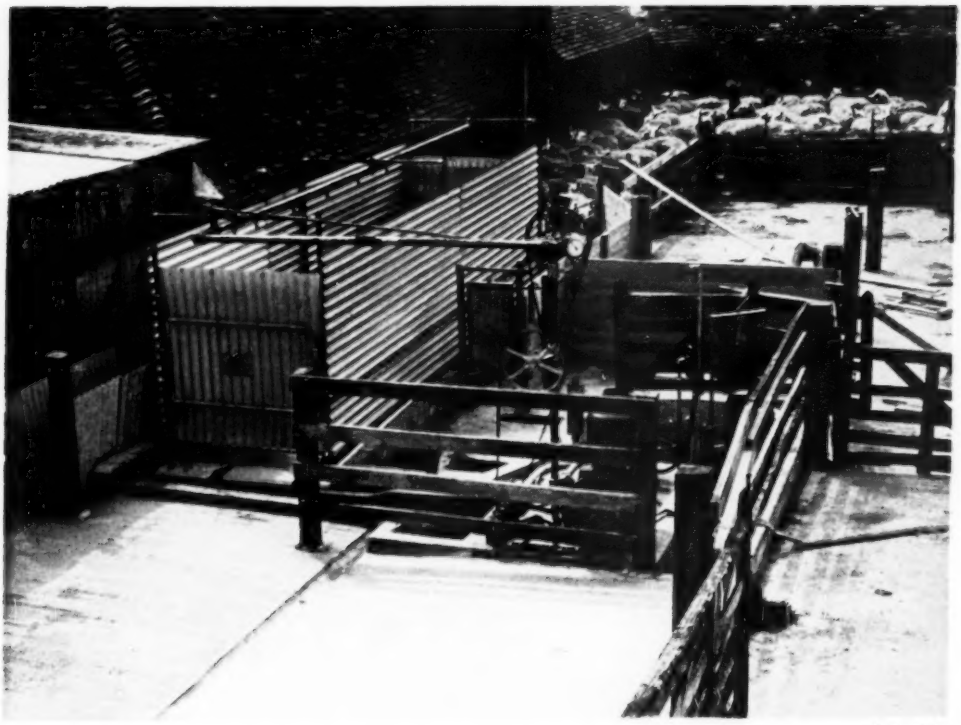
Top : Unlighted control.

Centre : Lighted August 2—30.

Bottom : Lighted August 16—September 13.

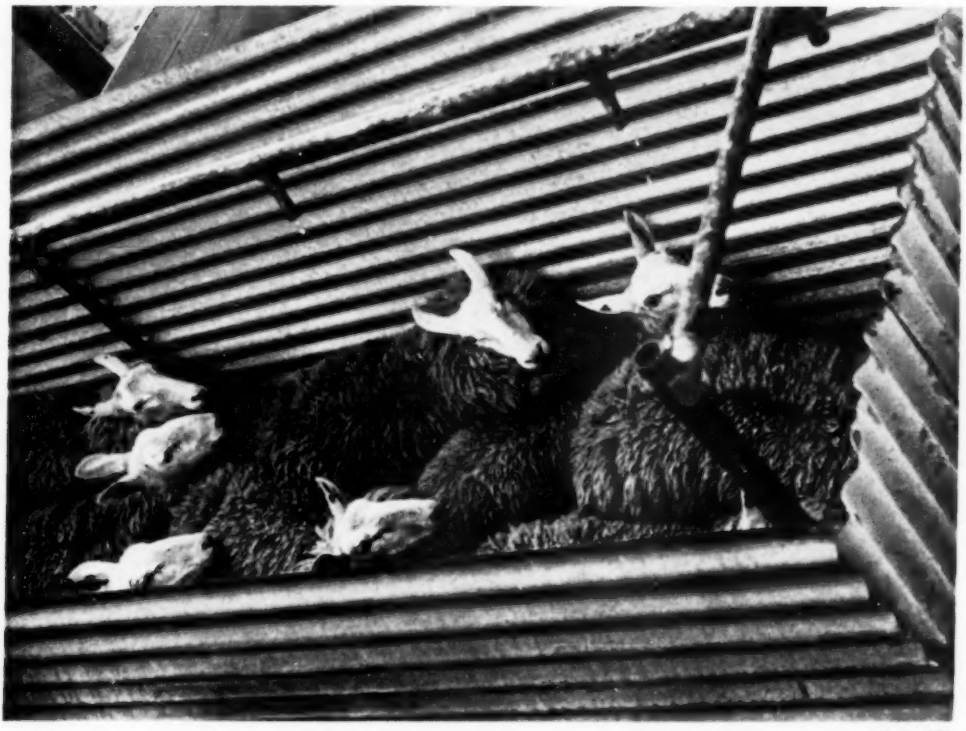
Photographs taken November 22, 1951.

SHEEP DIPPING, SHOWERING OR SPRAYING ? (See pp. 80-3)



A. C. Gibb

Layout of a sheep shower, 15 feet × 4½ feet, used in the trial.



A. C. Gibb

Sheep ready for showering.

FOOT-AND-MOUTH DISEASE

JAMES REID, M.R.C.V.S., D.V.S.M.
Ministry of Agriculture and Fisheries

Losses caused by foot-and-mouth disease in Western Europe last year are estimated to total £313 million. This dreadful scourge is a constant anxiety to every stock farmer and a challenge to scientists and governments to control and finally conquer it.

NOT so very many years ago it was by no means uncommon for the unfortunate owner whose herd had contracted foot-and-mouth-disease to say, " Yes, I know the law says you must slaughter all my cattle, but I can remember my father telling me that he once bought some store beasts that had foot-and-mouth disease, and he grew them, fattened them and made a nice profit". In the neighbourhood of outbreaks, too, there is often a good deal of doubt whether all the fuss and bother is necessary and the very stringent precautions justified.

As no doubt many of the farmers of today have had those impressions handed down to them (along with some very good stock !) it might not be amiss if, some sixty years since the introduction of the much-discussed slaughter policy in this country, we ask ourselves if there really was something in the views of those fine old judges of livestock. Also, with last year's comparatively severe visitation of foot-and-mouth disease fresh in our minds, we might profit by looking at the effects of the disease in those countries where it is always present, and therefrom try to assess the probable result of allowing foot-and-mouth disease to become widespread in this country.

A description of the condition, how it affects stock, the course of the disease, the possible losses and the probable duration of convalescence, may help those who have not seen the disease or had the misfortune to experience it in their livestock, to a better appreciation of why foot-and-mouth disease is so dreaded by farmers and Governments alike.

The Invisible Virus The disease, caused by a virus which is too small to be seen under the ordinary high-power microscope, affects cattle, sheep, pigs, goats and wild cloven-hoofed animals.

In a typical case of foot-and-mouth disease seen in the early stages when there is a high fever, the lesions consist of vesicles (blisters), varying in size and shape, which break liberating a clear fluid and leaving a raw surface. In cattle there are lesions on the tongue, inside the lips, the dental pad and around the coronet at the junction of the skin and the hoof, between the clays and on the bulb of the heel. In sheep, blisters are very similar to those in cattle. They are not often seen in the mouth but always on the feet. In pigs, lesions are uncommon in the mouth but are sometimes seen on the snout and are always on the feet. Udder and teat lesions are often present in the female of all species. Abortions occur. In some cases a chronic heart condition develops, while in dairy cows mastitis is a fairly common sequel. When secondary germs invade the raw surfaces of the feet, suppurative reactions may cause sloughing or shedding of the hoof and result in permanent lameness.

A high proportion of animals recover naturally—deaths in adults are rarely above 1–2 per cent. There is, however, the risk that following a

prolonged period of convalescence, maybe weeks or in some cases even months, the after-effects may permanently reduce the value of the stock. In young, unweaned animals the mortality may be high, and occasionally a severe form of the disease may cause a 50 per cent death-rate.

In the early stages of the disease, when the animal is suffering from a high fever and acutely painful mouth and feet, a fat animal rapidly loses condition and there is a severe reduction in the milk yield of dairy cattle. The stock continues to depreciate in value, earns nothing, although costing more to keep and tend, while at the same time manufacturing infection which menaces neighbouring herds, and they in turn infect others until the country is overrun. These are the two main reasons—economic loss and exceptionally high infectivity—which make the immediate eradication of foot-and-mouth disease, not in itself usually fatal, a matter of such vital importance in the economic policy of a country.

It is a recognized fact that neither breed nor the manner of feeding has any influence on the susceptibility or resistance of livestock to foot-and-mouth disease, nor do they in any way affect the severity of the condition ; but it should be emphasized that the better the condition or the higher the milk yield of the stock the greater the loss to the individual owner and therefore to the country.

Had we the assurance that after an attack of foot-and-mouth disease permanent immunity would result, the disease might not be so dreaded. Unfortunately that is not so. Perhaps the ugliest feature of this scourge is that like the ordinary infectious "cold" of humans, there are several types of the virus, all of which are able consecutively to affect the same animal or herd ; an attack by one type virus confers no protection against the next. Moreover, immunity developed as a result of an attack of the disease wanes, so that a beast may be susceptible later to the same type virus.

It might perhaps be convenient here to look briefly at the results so far achieved in the preparation of a protective vaccine against foot-and-mouth disease. Although much progress has been made during the last twenty years, the goal has not yet been reached. Factors which aggravate the condition to one of world-wide economic importance—the fact that there are several types of virus and that resistance is not permanent—are the same which have so far defeated attempts to produce a wholly satisfactory vaccine.

No one type of vaccine can immunize against all types of foot-and-mouth disease, but vaccines can now be prepared which protect against disease caused by the same type virus as that used in the production of the vaccine.

It takes two or more weeks for immunity to develop after vaccination, and because of the waning immunity revaccination with several type virus vaccines (at least three types of virus are prevalent in Europe and variants of these may arise) would be necessary every six months to keep all stock protected all the time. A permanent vaccination policy and the production of such large quantities of vaccine against every type of virus does not seem practicable and would be extremely expensive. The alternative—vaccination in the vicinity of outbreaks using the appropriate vaccine—demands preparation and supply of vaccine and the vaccination to be conducted speedily once the disease makes its appearance. In spite of these weaknesses, this latter policy may no doubt serve a useful purpose in countries having common land boundaries where, because disease is endemic, control has never been practised and complete eradication is impossible.

The Outbreaks of '51 and '52 It is believed that imperfections in, or a breakdown of, this "ring" vaccination system around infected farms or districts was largely responsible for the very serious spread of disease throughout Western Europe in the second half of 1951 and during 1952.

It seems from the evidence available that the epizootic started in Western Germany, where presumably the generation of stock involved in the last 1937–38 epizootic (and which would be partially resistant) had been almost completely replaced by a new generation which, for lack of exposure to infection, would be relatively susceptible to the disease. Following a fairly normal year when 615 outbreaks were recorded in the three Western Zones, disease flared up about midsummer of 1951 and gave rise to the alarming total of 154,478 outbreaks in the twelve months ended December 31, 1951. International frontiers, like county boundaries or farm fences, form no barrier to the spread of such a highly infectious virus disease, and by the time Germany's figures reached their peak in November, outbreaks in bordering countries had already shown an appreciable rise.

The extraordinary rapidity with which disease radiated is perhaps best illustrated by the following outbreak figures for W. Germany and those countries bordering on the North Sea and English Channel during the last six months of 1951.

	June	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
W. Germany (3 zones) ..	637	2,016	11,632	22,661	42,696	45,363	26,841
Denmark	—	—	2	55	1,367	9,194	12,862
Holland	4	29	27	109	5,198	12,260	2,935
Belgium	16	3	—	47	6,261	23,563	20,122
France	191	608	1,232	1,397	1,050	1,431	2,422
Great Britain	—	8*	2*	—	—	42	46

(*not considered to have a Continental origin).

All the Continental countries mentioned above, with the exception of France, had reached or passed the peak of the epizootic by January 1952. In France, however, a large straggling country, the number of outbreaks increased up to July, when in that month 111,637 were recorded.

Disease which had reached the coastal provinces of the Low Countries by the autumn is thought to have been conveyed mechanically to livestock in the eastern counties of Britain by migrating birds (1). Numerous fresh "strikes" from as far north as Yorkshire and as far west as Devon occurred from the end of November 1951 to August 1952. In spite of the usual precautionary measures, which of course included the immediate slaughter of all affected and contact stock, secondary outbreaks did occur. The most threatening spread in Britain emanated from an outbreak of unknown origin in Cheshire.

From there, disease spread locally over fairly wide districts of that county into Staffordshire and Shropshire, causing many outbreaks. Stock movements from Cheshire led to infection being spread from many Midland markets east and south as far as Oxfordshire. Calves which had been fed on rail at Crewe on what proved unfortunately to have been infected milk took disease to Scotland as far north as Perth and Aberdeen, from where it spread to a western isle, Wigtownshire and the south-west of Scotland. In all, it is estimated that of the total outbreaks (579) in Britain up to September 1952, when the epizootic was finally brought under control, some 281 outbreaks resulted directly and indirectly from the Cheshire disease centre.

Total compensation to owners in Great Britain's 495 outbreaks during 1952 and the 88 in November and December 1951, was £2,736,067. This appears costly perhaps, but by this policy (costing on an average approximately £363,000 per annum over the last thirty years) Great Britain was once more free from disease, whereas Continental countries other than Switzerland and Sweden (both of which adopt a modified slaughter-cum-vaccination system) are still in its grip.

The following table of outbreaks is illuminating :

	1951	1952
West Germany	154,478	54,572
Belgium	50,358	8,498
Holland	19,196	7,206
Denmark	23,492	4,277
Switzerland	317	109
Sweden	459	374
Great Britain	116	495

Economic Loss of International Importance Obviously there cannot be a very accurate estimate of the losses sustained, but from the figures available the following indicate the immense damage caused by the disease. An epizootic which occurred in Germany in 1937–38 (some 666,576 outbreaks were recorded there in 1938 alone) was estimated to have cost that country about £83 million. French losses in the recent epizootic up to the beginning of August 1952 were about £153 million. Total Western Europe losses for 1952 have recently been estimated to reach £313 million.

What about the losses which cannot be reckoned in terms of pounds or dollars—the meat, the milk, not to mention all the other products and by-products and the food which was needed to feed the sick and recovering animals ? All these Europe and the world can ill afford.

In some countries where oxen are used for farm work peasants are unable to cultivate their holdings because their animals are incapacitated through disease. This adds cereals to the losses already mentioned.

The Departmental Committee appointed by the Minister of Agriculture and Fisheries to consider the outbreak of foot-and-mouth disease which occurred in 1923–24 reported that " the control of foot-and-mouth disease is clearly a matter of national importance " (2). In Britain, home of pedigree and high-grade commercial stock, this control is even more imperative today. We might go even a stage further and suggest that the Departmental Committee's recommendation could now read " a matter of *international* importance " ; and in this connection it is encouraging to note that the control of the disease is engaging the interest of the Food and Agriculture Organization at whose meeting in September 1952, at Copenhagen, attended by representatives from Britain and many European countries, an effort was made to achieve Continental control of foot-and-mouth disease. As a result of this conference, a detailed plan has now been drawn up for the establishment of a European Commission for the control of foot-and-mouth disease. In addition to a number of co-ordinating and fact-finding functions, the chief purpose of the commission would be to maintain a register of the stocks of foot-and-mouth disease virus and vaccines in member countries ; to assist members in storing and renewing such stocks ; to facilitate arrangements between countries for joint action in producing and storing virus and vaccine ; and to assist in making available emergency supplies of virus and vaccine when outbreaks of the disease occurred.

This plan, if successful, should result in containing or " damping down " potential epizootics on the Continent and could therefore be of great benefit to Britain.

The freedom of this country (and preferably the whole world) from the ravages of foot-and-mouth disease is of very great importance to everybody. The eradication of the disease has undoubtedly been worth all the work and every pound spent on the policy since 1892, when the policy of slaughter was introduced to combat the disease.

Not all this country's foot-and-mouth disease troubles originate on the European continent. There are long periods when the disease, though endemic, is neither sufficiently virulent nor sufficiently prevalent in the coastal regions of the Low Countries and France to threaten the health of British livestock. During those periods, in fact at all times, there has been and is a constant but unavoidable risk of disease being introduced by imported meat.

Risk from Imported Meat We are obliged to import meat, and unfortunately some of the sources from which it is available in worthwhile quantity are not free from foot-and-mouth disease. It is a fact that twenty-four hours or even more before showing symptoms of disease the organs, tissues, body fluids and bone marrow of infected animals contain much virus. If the meat of such an animal slaughtered is kept at a low temperature, so as to prevent chemical changes and decomposition, the virus will survive for a long period and there is therefore a recognizable risk that such meat, scraps from it or the bones may convey disease into the importing country. To avoid such risk would be to cut off meat imports entirely from countries where disease exists. As this cannot be, it behoves all concerned to see to it that the requirements of the Diseases of Animals (Boiling of Animal Foodstuffs) Order of 1947 are strictly observed, so that not only swill but even odd bones or scraps are made safe by boiling, and no animal has access to them before they are boiled.

Carelessness in boiling swill and delay in reporting a suspected case are both unforgiveable offences. Careful attention to the first can prevent an outbreak ; to the second, it can successfully limit the spread of the infection. No precaution is too elaborate.

Farmers hope for, scientists strive after, and the world needs, the solution to the problem set by foot-and-mouth disease, and until it is found countries that can keep it out should continue to make that their undeviating aim.

References

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SHEEP DIPPING, SHOWERING OR SPRAYING ?

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The efficiency of modern sheep dips to control ectoparasites of sheep is well known. Trials at Berkhamsted have been directed at finding out whether as good results can be obtained by showering or spraying as by dipping.

THE terms " shower dipping " or " sheep showering " are in general use in Australia, where installations for this purpose were first developed fifteen or more years' ago and are now widely used. They refer to the penning of a number of sheep on a concrete floor, where they are subjected to a deluge of insecticidal wash from moving overhead nozzles and stationary nozzles underfoot. Each nozzle delivers a large volume of wash at a comparatively low pressure which drenches the sheep and runs off on to the concrete floor, whence it returns to the sump to be drawn up again by a pump. Each batch of sheep is held in the shower for 3–4 minutes, after which they are released to a concrete draining pen similar to that used with a standard dipping bath.

In contrast to this drenching with a large volume of wash, sheep may be "sprayed" comparatively lightly, either by hand or by passage through a race in which a number of nozzles produce a fine misty spray. In this type of spraying there is no attempt to saturate the fleece to the point of run-off ; a much lighter application is made, possibly of a more concentrated wash. Usually, there is no attempt to collect any spray not actually applied to the sheep or which runs off the sheep, and this material is thus wasted. Between these two extremes of showering or light spraying there is obviously the possibility of a large number of compromises.

In comparison with dipping, the advantages of showering are that less labour and less physical handling of the sheep are needed. It is quicker than dipping and a smaller volume of wash can be used at any one time, thus enabling the residue of dirty wash to be discarded at intervals and the sump to be replenished with fresh, clean wash. A spraying installation, using a less dense spray without collecting and re-circulating the wash, might have the considerable further advantage of portability, but portability must not be a substitute for efficiency. In trials described below, an installation imported from Australia was used, as well as two experimental spraying installations.

Layout of the Sheep Shower The sheep shower used in the trial consists essentially of a pen about 15 feet long and 4½ feet wide (see page iv of art inset). At ground level there are a number of nozzles, arranged in two rows, each producing a cone-shaped spray directed upwards. Overhead, a central row of rocking nozzles, each producing a fan-shaped spray, combine to give a sheet of spray extending the whole length of the pen, and moving back and forth from side to side. The pump is a 2-inch centrifugal type, running at 2,100 r.p.m. with a capacity of 5,000 gallons per hour, and requiring 4 h.p. at sea level. The sump capacity is normally 500 gallons, although this has been made smaller in some of the British installations. The shower pen and draining pens are of concrete and drain into the sump. The operation of the shower keeps the liquid in the sump constantly agitated and, by means of a three-way cock, the wash may

be passed through the top or bottom nozzles, or both at once, or the nozzles may be cut off and the wash returned through a four-jet agitator in the bottom of the sump.

Twenty-five to thirty hill sheep, or about eighteen adult lowland sheep, may be penned in the shower at one time, and showering proceeds for three minutes. When there is more than 6–8 weeks' growth of wool on the sheep, a system of one minute bottom, one minute top, and one minute top and bottom nozzles together, may assist penetration, since the liquid issues with more force when one set of nozzles is in use.

Showering and Sheep Scab In view of the widespread use of dipping for the prevention or cure of sheep scab in Great Britain, the suitability of the sheep shower for this purpose is obviously of importance. In the winter of 1948–49, trials were carried out to test this point. A wash containing 0.033 per cent gamma BHC was used, which is more than double the concentration necessary for the cure of scab in a single dipping. Groups of sheep with 5–6 months' growth of wool were sprayed for up to six minutes, but, at best, only 30 per cent of the infected sheep were cured and, furthermore, little confidence was felt that a cure was complete in these cases. It was significant that infection was most persistent on the lower surfaces of the body, particularly the crutch, abdomen and throat, the close-woolled sheep being worse than the open-fleeced varieties.

It seemed clear, therefore, that the showering was insufficient to penetrate the natural barrier of greasy wool underneath the body, whereas on the top surfaces the natural effect of gravity enabled the wash to reach the skin. It was concluded that the shower could not be recommended for the prevention or cure of sheep scab. There is, of course, no alternative to dipping approved under the Sheep Scab Orders in this country.

Maggot Fly In further experiments a technique which has been in use at the Cooper Technical Bureau for several years for testing dips for the control of Maggot fly (*Lucilia sericata*) was used. Groups of sheep were confined at weekly intervals in a special chamber with a free-flying population of about 3,500 Maggot flies. Sheep treated in the shower dip were then compared with untreated control groups and groups of dipped sheep. Many different formulations and different concentrations of insecticide have been tested by this technique, but a wash prepared from a wettable powder and containing 0.4 per cent para para DDT may be taken as typical. Sheep *showered* with a wash of this kind were protected from fly-blow for a similar period to the groups *dipped* in a wash of the same concentration. The total number of sheep in these trials was about 600.

Although the results of the trials were very good, a slight doubt was felt whether showering was likely to prove as efficient as dipping for the control of crutch strike. This was a point which could not very well be tested by the technique described, but it was felt that the results obtained were sufficiently encouraging to warrant practical field trials, and arrangements were made for installations to be imported.

In 1951, seven farmers installed the imported sheep showers and co-operated in carrying out trials. The farmers concerned were supplied with a 50 per cent DDT wettable powder, usually used at a strength of 0.3 per cent pp' DDT for the trials, but certain proprietary dips were also put through the showers. The trials consisted of about sixteen showerings (roughly two per farm) during the Maggot fly season, and results showed that a protection was given comparable to that produced by dipping. The amount

of wash used per head of adult sheep in each showering varied from 0.15 gallons for 3½ weeks' shorn ewes to 0.8 gallons for sheep in full fleece. Few strikes occurred on the treated sheep ; almost all that did occur were crutch strikes. Sheep were in all cases protected for a month to six weeks, and the field trials confirmed the biological tests of the Bureau. It is always difficult to assess the severity of a seasonal attack of fly, but 1951 was reckoned to be an average season. The shower installations were also used by two farmers to wash sheep before shearing with a weak anionic detergent solution, but no data is available of the economics of this procedure.

All the farmers using the shower were very satisfied with the equipment and shepherds certainly preferred this method of treating the sheep since it involved less manual labour and there was no danger of harming the animals. The sheep went through the shower very readily indeed and on no farm were there any difficulties in its use.

Spraying Methods Tested While the additional sheep showers for field trials were being obtained, two methods of spraying were tested. In the first series a crop sprayer was used in which a blast of air carried insecticidal wash on to the sheep. This sprayer was used as a run-through spray race, the sheep taking two seconds in transit. There was no return of the wash to the sump.

A 3 per cent pp' DDT wash was used, the sprayer using two gallons per minute, and the strength of the wash was calculated to give the equivalent insecticidal deposit contained in five pints of normal wash, which is approximately the amount removed from the dip bath by sheep.

A coloured wash was used so that the penetration of the fleece could be observed, and it was seen that little wash got through the outer layers of wool ; for example, in a lamb in normal fleece the penetration was only ⅛–¼ inch.

Protection was given in the fly chamber for about half the period that is normally obtained by dipping, and it was concluded that this type of sprayer was no more efficient for treating sheep against Maggot fly than the much simpler and more conventional bucket pump spray, which itself is not so effective as dipping.

A further series of trials was carried out with an experimental tunnel-spray race. This again was of the non-return type and consisted of five horizontal spray booms, two on each side and one overhead, each carrying three or four jets giving a fish-tail spray. The five entrance-end jets were specially adjusted to spray the crutch area. The sides of the race were covered, but it was unnecessary to cover the top as the jets were directional. The pump was driven by a 3 h.p. engine, giving a pressure of 10 lb. per sq. in. at an output of about 10 gallons per minute. When the sheep were running satisfactorily through the race at about sixty per minute, this represented a wash consumption of more than one pint per sheep. The groups of sheep were treated with washes containing 0.3, 0.6 and 0.9 per cent pp' DDT. The results with this spray were most disappointing, as the protection given was very slight, and even with a 0.9 per cent pp' DDT (three times normal dipping strength) and passing the sheep through the race twice, the protection was negligible.

In any run-through race, without return of wash to the sump, there must be a considerable wastage of wash, but this did not seem to be excessive and was not judged to be the cause of the failure. The problem of Maggot fly control appears to depend almost entirely on adequate penetration of the

wash into the fleece, and our experience leads us to believe that this can be secured by dipping or showering, but *not* by light spraying. Difficulties were encountered with some sheep (notably Southdowns) in getting them to run through the race. It was concluded that the run-through spray race, as tried, was not an attractive or economic proposition and, in view of the lack of protection, these experiments were abandoned.

Management of Sheep Showers In connection with showering, a note should be added regarding the management of washes. In normal dipping, a bacteriostat is added to prevent the growth of bacteria in the bath. These bacteriostats are not suitable for use in showers because of corrosion difficulties. It is therefore essential that a clean wash is used for each showering and that the remains of the old wash are thrown away. The size of the sump, accordingly, requires careful consideration. In use, a certain amount of insecticide is lost on the floors of the draining and showering pen, and there is a certain amount of sedimentation in the sump. Furthermore, the wool of the sheep acts as a filter and filters out particles of the insecticide from the wash. For these reasons, therefore, it is necessary not only for the sump to be replenished, but for additional insecticide to be added to make good that removed from the wash remaining in the sump. The instructions of the maker of the shower dip material should be very carefully followed on these points.

It must be emphasized that the instructions for the use of a wash in a dipping bath are not necessarily applicable to a shower. Despite the necessity for replenishing the wash in the sump, the actual amounts of insecticide used are similar to those used in dipping. If showering is well managed, there is comparatively little waste material left in the bottom of the sump. The cost of insecticides when showering is similar to the cost of materials when dipping.

Conclusions The majority of sheep farmers have for many years been aware of the efficiency of modern sheep dips in the control of ecto-parasites of sheep, particularly sheep scab and Maggot fly. There is now some evidence that showering sheep may give protection against fly comparable to dipping, but it must be stressed that experience during a season of more severe Maggot fly attack than has been the case during the period of these experiments is needed before firm claims can be made. On the other hand, the Cooper Technical Bureau have tested various methods of spraying sheep, using insecticides of the type now generally in use, but in their tests neither hand-spraying nor the spray-race method gave results approaching those achieved by dipping or showering.

The advantages of showering sheep compared with dipping for the control of Maggot fly lie in the greater ease and speed of handling large numbers of sheep, and in the convenience of treating sheep in full fleece in the event of an early fly season. The insecticidal wash remains cleaner and freer from contamination with dung. Possible disadvantages of showering are the initial cost of the installation and the inability of the method to control sheep scab. There is also the question, as yet undecided, of the degree of protection afforded against crutch strike.

MUSTARD

FRANK H. GARNER

Under modern husbandry methods the former importance of mustard as a green manuring crop has declined. Today, it is mainly grown for seed for processing—nearly always on contract. The new variety, Trowse Black, appears to offer advantages over the older types and may enable the crop to be grown outside the traditional areas.

MUSTARD has been grown as a commercial crop in East Anglia for many years, and the main object of growing it has been to produce seed for processing into the condiment which has become a commonplace of the domestic table. On the Continent the crop has been grown for the production of oil for well over a hundred years. It is very doubtful, however, whether the crop is likely to be a really important source of oil either now or in the future, since it has been surpassed by other oil-producing plants.

Mustard has also been grown to provide seed for green manuring purposes on the lighter lands in Britain, but the quantity of seed required for this purpose must be very small indeed ; and it is becoming less popular as a green manuring crop than it was in the early part of this century.

In the days when arable land sheep were kept, mustard was often grown on the light land to provide food in July and August to flush the ewes at tupping time, but the real feeding value of this crop was not high. Now that arable flocks have declined and other crops have appeared, the crop is little, if ever, grown for this purpose today. In times of drought mustard grown for green manuring was sometimes appropriated for the sheep.

Mustard is still grown in East Anglia under two conditions : on the lighter soils, where the primary object is green manuring and sometimes seed for oil ; and in the Fens, where it has been taken as a regular crop for seed production only.

Mustard on Light Soils White or Yellow Mustard has been the variety grown on the light soils throughout East Anglia, both for seed and green manuring. Cultural treatment depends on what the crop is wanted for. If grown for seed, then drilling must take place between early April and the end of May in a normal seedbed (as for roots) so that the seeds can be sown shallow. The seed rate is a peck per acre, or not more than 14 lb. Since it has been looked upon as a cleaning crop, the rows are usually 18 inches apart in order to facilitate hoeing. The crop is liable to suffer from frost, and therefore too early drilling should be avoided ; but if drilled too late the yield of seed is likely to suffer seriously and harvesting may be pushed into late autumn. The crop invariably germinates very quickly—in favourable conditions it may be up in a matter of three or four days. This affords a first-class opportunity for inter-row cultivation, since mustard grows faster than most weeds and it can therefore be a very satisfactory cleaning crop. It is often in order to clean land that mustard is grown on the poorer sandy soils of East Anglia.

Under light land conditions, to ensure a satisfactory crop, the manuring is as for barley, namely, 3 cwt. complete fertilizer per acre. It is not wise to use a combine drill, because fertilizers may damage the seedlings. Drilled in April, mustard will normally be ready for harvest by early August, and

it is normally cut by reaper and binder and handled just like a cereal crop. It is possible to use a combine harvester, but it is unwise to combine direct because of the uneven ripening of seed (often mature seed and flowers can be seen on the same plant), and the sample may heat after combining. It is very difficult, if not impossible under farm conditions, to dry mustard seed in an ordinary drier as used for corn. If the crop is a little damp at threshing time it will heat in storage, and grey seed will be produced which is of lower sale value than the bright yellow seed which the trade demands. To achieve this bright colour, if combining is intended, the crop should be cut and left in windrows for several weeks before combining. The yield of mustard seed obtained on the light land is often some 8–10 cwt. per acre.

Still keeping to the light land, the yellow mustard may be grown as a green manuring crop for use at almost any time in the summer. Drilling or broadcasting may take place between April and August and, given a normal season, the crop will be ready for ploughing in six to eight weeks after drilling. In general, broadcasting gives better results for a crop for green manuring ; it produces a better cover to the land. For broadcasting, the seed rate is often put up to 20 lb. per acre. Occasionally the crop is broadcast after a crop of peas has been harvested—which may mean that drilling does not take place till August. Sometimes, on the lighter soil, it is possible to drill and plough in two or three crops of mustard for green manuring in one season.

Just one further point on green manuring should be mentioned. After the normal crop of mustard has been taken, a lot of seed is invariably shed on the land, often making it very desirable to stubble clean by taking a cultivator across the field. This will frequently produce sufficient tilth to germinate a considerable proportion of the shelled mustard, which can later be ploughed in before the land is cropped for another season. It also has the added advantage of ridding the land of the seed, for it is well known that shelled mustard seed can live in the soil for a great many years.

Mustard in the Fens Two main varieties of mustard have been grown in the Fens—the White (or Yellow) mustard and the Brown (also called Black). The growing of this crop has been declining in the fenland areas during the last few years and will continue to do so owing to the Sugar Beet Eelworm Order, because mustard is one of the alternative hosts for the Sugar Beet eelworm. Whether the new variety of mustard called Trowse Black, which has appeared on the market in recent years, will affect the growing of mustard in the Fens is very difficult to forecast. However, a brief description of the way in which the mustard crop has been grown in the Fens may indicate where the new variety may perhaps play an important part.

In the Fens, White mustard has been grown in much the same way as on the high lands ; but never for green manuring, always for seed production. The seed rate is about 3 lb. per acre and the width of drills 18–21 inches. The time of drilling is about mid-April, and then the crop is ready for harvest at the same time as the cereals. It is, however, possible to drill the crop in May, which enables the corn harvest to be got out of the way first. It is not usual to find mustard being grown on the best Fen soil, but rather on the light, blowing fenland where germination is much quicker and consequently the risk of loss is less than for the normal root crops.

Under Fen conditions, manuring is quite different from that on the high land. It is a mistake to use nitrogen ; the normal manuring has been about 4 cwt. superphosphate per acre and, on the lighter soils, a further 2 cwt. muriate of potash. Even with this manuring, the crop grows vigorously up to 6 feet tall (compared with 2 or 3 feet on light soils), and it is impossible to cut it with a reaper and binder. To gather a satisfactory crop, the method has been to cut by sail reaper and to leave it in heaps with the minimum handling, because when it is dry and brittle it is a "touchy" seed and flies readily from the pods. The usual yield in the fenlands is 12–14 cwt. of good seed per acre.

Brown mustard has invariably been grown in the Fens to replace White mustard. The former usually commands a higher price than the White, and since it also gives a higher yield per acre, it at first sight appears a more satisfactory crop to grow. There is, however, a penalty, in that once you have Brown mustard on the land, it is said you can never get rid of it !

Cultivation and manuring are the same as for Yellow mustard in the Fens, but drilling may take place as early as February, since the crop is rarely affected by frost. This earlier drilling is a great advantage, for it means that the crop is ready for harvesting in late July—that is, before the cereals are ready—and so spreads the harvest. After drilling, the seed is soon ready for hoeing, and to facilitate good branching the crop is often cross-harrowed when about 3 or 4 inches high. This will thin the crop and save hand-singling. Some farmers cross-block and in that way avoid hand-singling.

Sometimes it is essential to spray against the Mustard beetle, which attacks the crop from May onwards. This beetle may seriously reduce the yield if no spraying is done.

The crop grows vigorously, frequently standing when mature 6–8 feet high, and harvesting is a difficult problem. It is impossible to cut these " mustard trees " with a reaper and binder. The old method was to use the sail reaper and to cart loose but the modern method is to cut and leave the crop in windrows on long stubble, then later, when the crop is fit, it is combine harvested. The seed sheds very easily, so the crop should be cut slightly on the green side, given plenty of field room and, if possible, threshed with the combine where it lies. If the crop is carted, all vehicles used must be covered with sacks or cloths to catch the shelled seed. The yield of seed is much affected by the season and harvesting conditions, but may reach 15–20 cwt. per acre.

The Brown mustard grows so vigorously that it dominates other crops, and it is reported that it (as a self-sown "weed") has smothered the new Trowse Black mustard when the latter has been sown on fields where Brown mustard has been grown previously. This is mentioned to show the vigour with which the Brown mustard grows. It is, of course, quite true to say that the shelled mustard seed can be easily killed by spraying if the seedlings appear as a weed in cereal crops, but in sugar beet and potato crops self-sown mustard can be a terrible nuisance—quite as bad as charlock on the chalk soils of the south of England.

Extension to Other Areas As to the future, there is little possibility, in view of the Eelworm Order, that the acreage of mustard grown in the Fens will be increased. But the question of extending

the mustard seed crop to other land is worthy of consideration. If there is an extension, then the variety will undoubtedly be the new Trowse Black. Although likely to be about 6 feet tall, it will very rarely be so high that it cannot be managed by ordinary farm equipment. It does not shed its seed as do the older varieties, and therefore it will be easy to handle with a combine harvester. It is also reported that the yield of seed per acre is 50 per cent higher than that from the older varieties. It should be ready for harvest 90 days after drilling, but so far no comment has been made regarding its frost hardiness. In view of its quick growth, however, drilling may take place in May and still not make a late harvest. It appears that Trowse Black does not suffer from the disadvantages of the Brown, and possibly the Yellow varieties, and so may be considered for further growing. It is a crop that may be grown as a fodder and cleaning crop in areas where there are no sugar beet factories, but care must be taken to see that the climate is suitable, for it must be dry at harvest time. There appear to be good prospects of growing the crop on high land in the south of England, and especially in the east. It is wise, however, to grow the crop on contract so that there is a sure sale for the seed.

THE EFFECT OF SUMMER WEATHER ON CABBAGE ROOT FLIES

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Although the summer generation of Cabbage Root flies is numerically greater than that in the spring, the hot, dry weather of June and July is less favourable to the development of the flies, and the amount of crop damage in summer is thus considerably less than that in spring.

THERE are few times in the year when farmers are free from anxiety about pests on their crops and none when market growers feel reasonably safe from the depredations of insects. Both have learnt that severe and prolonged wintry weather has little effect on their enemies, and since each spring and summer brings obvious signs of insect activity in fields, orchards and gardens, it appears that climatic conditions have only a minor place among the factors influencing the intensity of insect outbreaks. This appearance is deceptive. During warm, dry, sunny weather about midsummer when insects are most numerous and active in crops and hedgerows, many highly injurious species have their greatest struggle for existence.

For several years the writer has carried out field investigations in the south-east of England on the biology of the Cabbage Root fly (*Erioischia brassicae* Bché.) and a number of closely related species. The observations suggest that the greatest single factor affecting the numbers and activity of the flies is the weather. It determines when they appear, how long they

live and how many eggs they lay, and at certain times of the year it may so reduce their food supply that large numbers fail to survive long enough to lay eggs.

The outline of the life history of the Cabbage Root fly is familiar to all growers of brassica crops. During the winter the slow development from pupa to fly takes place within the golden or reddish-brown puparia, shaped rather like grains of wheat, which are to be found in the soil among the roots of winter brassicas. In spring the flies become active, break open the tough cases protecting them and crawl through the soil to the surface. This first activity of the year is the result of the spring rise in soil temperature. Observations from 1948 to 1952 suggest that emergence begins when the soil temperature at a depth of 8 inches reaches approximately 47°F. In the years 1948, 1950 and 1951 the soil temperature rose gradually and regularly and the association between the emergence of the flies and a soil temperature of 47°F. was fairly clear, but in 1949 and 1952 the soil temperature rose erratically in response to sudden fluctuations of the air temperature, and had exceeded 47°F. and fallen again before the flies could complete their development and emerge.

It is obvious from what has been said that the irregular timing of the appearance of the flies is dictated by the vagaries of the spring weather. In 1948 the soil warmed quickly during sunny weather early in the year and the first flies emerged in the second week of April. In 1951 the spring was cold and damp and the first flies emerged at the end of the month. In the remaining three years under observation, the flies began to emerge in the third week of April. These differences in the time of emergence may have their sequel in the time of applying control measures.

Liquid Food Essential With some insects the development of eggs is more or less complete at the time they emerge from the pupal stage. Such insects require no food but wait to be fertilized and then lay their eggs without loss of time or waste of energy. The Cabbage Root flies and their relatives, however, use all their food stores in accomplishing the transformation from maggot to fly. Eggs are quite undeveloped at the time the flies emerge, and feeding must take place so that eggs may mature. It has been estimated that the period between emergence of Cabbage Root flies and the beginning of egg-laying is about four days. It is during the time that the eggs are maturing and being laid that the flies are exposed to the direct and indirect effects of the weather.

Like houseflies, Cabbage Root flies and their allies are so constructed that their essential food must be taken in liquid form. When they feed, the proboscis, which is usually folded under the head, is extended, and the fleshy tip with its rows of open channels on the underside is pressed against the damp surface of the food material. It is difficult to say with certainty what is the natural food of Cabbage Root flies. In captivity they lay fertile eggs when fed on sugar solution, and the frequency with which they have been observed on flowers suggests that they feed on nectar. But undoubtedly they have other sources of food. In dry weather they will leave the shelter of long grass on the headlands and suck moisture from freshly watered soil ; they imbibe sap from the broken surfaces of brassica plants ; and their habit of sheltering in herbage suggests that they may obtain food from decaying vegetation on the soil surface. When food and shade are provided, captive flies live 6–9 weeks and lay upwards of 100 eggs. This may not correspond with natural conditions but it gives some measure of the duration of life and capacity for reproduction.

THE EFFECT OF SUMMER WEATHER ON CABBAGE ROOT FLIES

Spring Weather Favourable to Development The spring generation of flies is active during April and May, and the weather at this time is generally favourable for their survival. "April showers and May flowers" ensure that moisture and food are available, and the spring sunshine stimulates them to fly in search of food and host plants near which to lay their eggs. The suitability of spring weather for the survival and reproduction of Cabbage Root flies was shown in 1952 by the numbers of eggs laid at plants under observation. Eggs were first found on April 22, and in the cool, unsettled period from April 22 to 29 eggs were laid at the low rate of rather more than one per day per plant. On April 30 the weather became warm and sunny. The response of the flies was immediate and the numbers of eggs rose to 20 per day per plant. They remained at approximately this number for three weeks, reaching as many as 46 and 42 per day per plant on May 8 and 9 respectively. By the time this spring peak of egg-laying was over (May 24), the plants under observation had received an average of 528 eggs per plant.

Was the number of eggs and the pattern of egg-laying normal last spring? That question cannot be answered, since there are no details of previous observations for comparison. But there is no reason to suppose that the season was exceptionally favourable, particularly as observations in previous years have shown that warm, bright weather is a necessary stimulant for egg-laying. The daily records of eggs showed how closely egg-laying was connected with the weather. Rain and cold wind during the day were sufficient to reduce the number of eggs to as low as 5 per day per plant, while an exceptionally fine, warm day caused a corresponding increase above the average of 20 eggs per day per plant.

The eggs hatch in a few days and the maggots burrow through the soil until they reach the roots of the host plants. The infested plants are thus subject to attack by a constant succession of maggots, the earliest being fully fed some time before the last arrive. No attempt was made on this occasion to estimate the effects of this carefully measured attack, since it was necessary for the purposes of the investigation that all the plants on the observation plot should remain alive and healthy. Against attack by Cabbage Root fly, as Worlidge* recommended nearly 300 years ago—"there is nothing so effectual as watering". As a result of this treatment, attacked plants and those from which the eggs had been removed flourished equally and could not be distinguished by the condition of the heads. It is recognized, however, that for most growers the timely application of an appropriate insecticide is more convenient and less costly than adequate irrigation.

Reduced Egg-laying in Summer It is impossible to say what proportion of the young maggots reach maturity but the numbers are certainly large. The writer has found as many as 86 maggots and puparia at one plant in early June, and large numbers have also been found by other workers. There is no doubt that large numbers of the mature maggots pupate and emerge as flies in June and July, and the ease with which puparia are found in May and June, compared with the arduous search required during the winter months, suggests that the summer generation of Cabbage Root flies is numerically greater than the spring generation. It might be expected, therefore, that plants exposed to attack at midsummer would receive eggs at a rate at least as high as that observed in spring, but in the south-east of England this is not the case. Counts in 1951 and 1952 have shown that the number of eggs laid is rarely more than

* J. WORLIDGE. *The Art of Gardening*, 1677, p. 281.

5 per day per plant, and that the summer attack from mid-June to mid-July is only about a quarter as intense as that experienced in a similar period in spring.*

It is remarkable that in the annual cycle of generations the greatest emergence of flies should be followed by such a sharp decline in the rate of egg-laying. Theoretically, a species made up of two sexes with females laying about 100 eggs each can maintain its population if only 2 per cent reach effective maturity. The hazards of natural life necessitate a rather higher survival rate to maintain the Cabbage Root fly population at its original level. But when infestation is reduced by as much as 75 per cent at a time when the numbers of adults are such than an increase in infestation is expected, it is obvious that some exceptionally adverse factor, widespread in its influence, operates to limit normal development. This factor is the daily weather.

June and July are generally hot, dry months, and heat and drought together create conditions in which moisture-loving insects such as flies have a precarious existence. The surface of the soil becomes baked and dry and traps the emerging flies in the ground or dries their wings before they are fully extended. More important, however, is the effect of hot, dry, summer weather on the availability of liquid food. Nectar-producing flowers become short-lived and scarce. There are no droplets of water about the host plants and any flow of sap from broken leaves dries immediately. The vegetation of headlands dries and dies, and the humid shelter which it provided for the spring flies is not available for the summer generation. There are few damp, decaying leaves in or near the crops, and weeds and soil disturbed by cultivation dry at once. Heat and sunshine stimulate the flies to great activity, but when they are deprived of food their lives are short and their powers of reproduction severely curtailed.

The deleterious effects of summer weather on Cabbage Root flies operate to a greater or less extent every year and are of major importance in limiting their numbers. Without understanding the reasons, farmers and growers have traditionally incorporated their experience of this phenomenon into their practice. Thus brassicas such as Brussels sprouts were always planted in the latter half of May and were considered immune from attack, although the present-day demand for early sprouts has led to much earlier planting in some districts and, in consequence, the crops are suffering more and more from maggot injury. In Thanet, cauliflowers and broccoli are planted extensively during the summer without insecticidal treatment, and crops of good quality are produced. It is apparent that this practice need not be modified so long as protective treatment in the seedbed ensures that the roots of the young plants are not damaged.

Since summer weather is not the same every year, or alike in all parts of England, identical effects on the Cabbage Root fly population will not always occur. But an appreciation of the part played by the weather in determining the intensity of attack will help to solve a number of problems—such as whether autumn cabbages should be protected against root flies—as well as encouraging the grower who seeks to work with nature to reduce to a minimum herbage which would shelter and sustain the flies at critical times.

As farmers and growers know from experience, the Cabbage Root fly population speedily recovers from the ill-effects of summer weather, and each

* Some data on which this article is based have been published in the *Annuals of Applied Biology* and the *Bulletin of Entomological Research*. A further account of recent investigations is now being prepared for publication.

spring the brassica crops are subject to apparently similar attacks. Some few of the maggots that reach maturity in the spring enter a resting stage from which they do not emerge until much later in the year, or perhaps not until the following spring. As has already been shown, even during the hottest and driest weather of the year some flies survive and lay eggs, and when this generation matures, in late summer or autumn, the weather is again favourable for a long adult life and normal egg-laying . Cabbage Root flies are capable of producing four generations in the year. They continue to emerge as flies until late September, and egg-laying goes on until the end of October if the weather is favourable to fly activity. Under these conditions it is no wonder that the pest recurs every spring.

Other Flies Affected by Summer Weather It is not often that an entomologist can make general statements. He knows only too well that the life histories and habits of closely related insects vary greatly. But the group of injurious flies which includes such well-known pests as Cabbage Root fly, Mangold fly, Onion fly, Bean Seed fly and also the Spinach Stem fly, are similar in that they all depend on access to liquid food for their ability to live and reproduce. All have several generations a year, the second of which appears during June and July, and consequently all are affected in a similar manner by summer weather.

Since 1947 the writer has observed in the south-east of England that attack by the Mangold fly (*Pegomyia betae* Curt) begins each spring but does not subsequently assume any importance in the crops. Attack by the Bean Seed fly (*Delia cilicrura* Rond. and *D. trichodactyla* Rond.) is always erratic, and so great is the sensitivity of the fly to climatic influences that differences in intensity of attack can be related to differences in weather at the time seedbeds are prepared. The Spinach Stem fly (*Hylemyia echinata* Seg.) is an important pest of spring crops of spinach grown for processing, but seems less prevalent in spinach grown later in the season. A species particularly exposed to the effects of summer weather is the Turnip Root fly, or northern Cabbage Root fly, (*Erioischia floralis* Fall.) which occurs in Scotland, Scandinavia and other parts of northern Europe, and in North America. The writer has reared this species in captivity for three years on a diet of sugar solution, and has found that it usually has only one generation a year and that the flies emerge from late June to early August. It seems probable that the geographic distribution of this species is determined by the weather regulating the supply of liquid food at the time of emergence. It is unlikely that it could become established in south-east England where such food is then generally scarce.

Farm Incomes in England and Wales

The fourth report in the Farm Income series prepared by the Ministry of Agriculture and Fisheries from the results of the Farm Management Survey, entitled, *Farm Incomes in England and Wales, No.* 4, 1950-51, should be of considerable interest to farmers, students of farm economics, and, indeed, to all who are in any way concerned with the development of the agricultural industry.

The report, which is obtainable from H.M. Stationery Office, or through any bookseller, price 6s. 6d. (6s. 8d. by post), is similar in substance to the earlier ones, and compares the financial data of farming in 1950-51 with those for 1949-50 on the basis of a sample of 2,303 farms in England and Wales grouped according to type of farming and size of farm. It comprises a short explanatory text, followed by tables showing the variation of net income with type and size of farm, and revenue and expenditure analysed item by item. There are also two bar charts illustrating the composition of revenue and expenditure.

FARMING AFFAIRS

Devon and the Food Production Drive The part that Devon farmers can play in the food production drive to contribute their quota of the " 60 per cent plus " by 1956 was outlined by SIR JAMES SCOTT WATSON at a conference organized by Plant Protection Ltd., with the support of the Devon A.E.C., at Torquay on April 14. Grass is still Devon's most important crop, and it offers great scope for development. To the old precepts of good husbandry—drainage, lime and phosphates—we can now bring new knowledge and new resources. Improved strains of quick-growing grasses can give us better yields of better quality. Poor seed is false economy ; good plants can come only from good seed, just as good livestock must have good parents. Like good stock, too, good grasses and clovers respond to good feeding, so a more intensive use of fertilizers—more phosphate and more potash—is called for ; early bite and late keep can be got by early and late dressings of nitrogen.

And having secured a good crop, the corollary is to utilize it efficiently—grazing and conservation so managed as to avoid all waste. It is here that strip grazing with the electric fence must claim the farmer's attention ; in terms of milk per acre, it can give an increase of 25 per cent, so making four acres do the work of five. We can cater for more livestock and still have acres to spare.

The importance of grass done well was also emphasized by a later speaker, MR. G. MAXWELL DAVIES, of the N.A.A.S. South-Western Province. He said that sustained output from our grassland depends in the three M's.—mixtures, manuring, and management. Successful grassland farmers have found that by replacing old worn-out grass by highly productive young leys, output has increased in many instances by at least 50 per cent and profit per acre correspondingly. He quoted the report of the recent delegation from the Milk Marketing Board which visited Australia and New Zealand last year : " The art and science of pasture utilization consists in getting the most out of the grass while it is growing, of conserving surplus grass as hay or silage to feed in summer and winter, and in doing these things while at the same time maintaining a balanced sward by controlled grazing."

Mr. Maxwell Davies made a special plea for utilizing pastures when the grasses are leafy and actively growing. Instances often occur where pastures are deliberately understocked or mowing meadows allowed to reach the full-flowering stage before cutting so as to secure more bulk per acre. But more bulk is not in itself an index of the productivity of grassland. A high output of nutrients per acre is more important—and that means more leaf and less stem. He claimed that silage is the most efficient way of conserving grass for winter feeding, and on every farm in Devon where grass is the main source of food for stock, there should be a place for silage. This is a point to be borne in mind when we remember how often stock are brought through the winter in poor condition.

The acres released from grass by the adoption of modern techniques can, said Sir James, be given over to cereals, for the old saying that the South-West country is " more apt for grass than grain " is no longer true now that we have stronger-strawed varieties. There is, too, a case for the revival of bean growing, and fodder beet should also do well, if the record crops of mangolds grown in Devon is any indication. Neither should the possibilities of early maturing potatoes as a commercial crop be neglected.

MR. H. P. ALLEN, Senior Botanist at the Plant Protection Research Station at Fernhurst dealt with the part that chemical selective weed-killers can play

in increasing food production. The practice is most highly developed in cereal crops and is becoming accepted too on some of our permanent pasture, but he emphasized that " first and last, this technique must work in with good husbandry and sound and enlightened farming practice." Evidence that selective weed-killing of reasonably susceptible weeds can appreciably increase grain yields in cereal crops has been amply demonstrated. " And what does it cost the farmer ? " he asked. He quoted, as an example, the spraying of 75 acres of wheat with MCPA sodium salt at the (high) rate of 5 pints per acre as working out at £1 10s. per acre ; by contract spraying the figure would be approximately £1 per acre.

Weed control in permanent pasture can also play an important part in any renovation campaign, thanks to recent research. Quite often, weeds such as buttercups, thistles, rushes, ragwort and horse-tail, are a serious problem and can be eliminated only slowly by even high farming. It is here that the new hormone weed-killers can play their role.

In our need to grow more and more of our stock foods at home, MR. J. F. H. CRONSHEY, Chief Scientific Officer at Fernhurst, directed attention to crop protection in this sphere as well as with crops grown for sale. Seed dressings of cereal seeds, peas and beans, grown as single crops or as dredge, is eminently desirable. Bunt of wheat has become a minor disease now only because of the general use of organo-mercurial seed dressings, but this situation might deteriorate in a few years, said Mr. Cronshey, if the routine of seed dressing ceased to be general practice.

Behind every farmer—large and small, the scientist stands today with the best advice that modern research can offer. The scientist cannot, as Sir James Scott Watson said, tell us *how* to farm ; much that is good in farming is the product not of the laboratory but of the experience of a hundred generations of practical men. But we should find the way to work into our farming, as quickly as we can, every scientific discovery that is potentially useful.

Wise Stock Feeding : 3. Quality Hay in the Diet

Hay must surely be one of the most sadly neglected crops on many farms today ; yet on these self-same farms it often forms the basis of the winter rations for growing calves, dairy cows or beef cattle. Too often it is of poor nutritive value and low digestibility because the crop has been cut at a mature stage or roughly handled in the processes of making. When cutting is delayed woody fibres are formed in the herbage plants, so that the fibre content increases and there is a net loss of protein. Rough handling causes leaf shattering, and this results in valuable minerals and proteins being wasted. Lucerne, sainfoin and leys rich in clovers are best cured on tripods or in pikes, thus minimizing loss of leaf and, at the same time, protecting the hay from weathering.

The mineral content of hay is important, for deficiencies of phosphorus can occur when indifferent hay is fed to stock receiving mangolds, oat straw, sugar beet pulp, kale, and other foods low in phosphorus. It is therefore necessary to ensure that adequate amounts of the appropriate fertilizers are applied wherever hay crops are to be taken.

Hay of low nutritive value may not even be good enough to provide fully for daily maintenance, so that on dairy farms where only hay and limited quantities of cake are fed, it will need to be supplemented with other feeding-stuffs to meet maintenance requirements. On such farms the quality of the

hay is of fundamental importance, and better quality hay may well be a decisive factor in preventing trouble with low solids-not-fat due to underfeeding. There was a noteworthy experiment illustrating this point in which two herds were given rations which differed solely in the quality of the hay being fed. The cows receiving the poor quality hay produced milk of lower solids-not-fat content.

Good hay can help to save expensive concentrates. A ration of 20 lb. good meadow hay with 1 lb. crushed oats would provide the maintenance requirements of a 10 cwt. cow and also give sufficient nutrients for ½ gallon of milk (or ½ lb. liveweight gain in the case of the fattening beast). With poor meadow hay, about 30 lb. would be needed together with 2 lb. dairy cake to achieve the same end. Moreover, poor hay is too bulky for the high-yielding cow, or the fattening beast which has to make rapid liveweight gains, and it is unsuitable for the calf since its digestive system cannot deal with coarse, fibrous fodder. Poor hay is expensive—we cannot afford it.

P. E. Farmer

Farming Cameo :
30. The Lias Clay Area of Warwickshire

The Lias clay area of Warwickshire comprises some 100,000 acres of low-lying, heavily "landed," and often poorly drained, land, bounded in the south and south-east by the Cotswolds and Edgehill escarpments and in the north-west roughly by the line of the Old Fosseway.

The soil is four- or five-horse clay, naturally rich in lime, unresponsive to dressings of potash but generally deficient in available phosphates. For this reason, the advantages of basic slag have received wide recognition in the area for many years. These natural characteristics make modern farming in this area relatively inexpensive from a fertilizer point of view, but the heaviness and the absolute necessity of working the land at the right time calls for high expenditure on heavy and powerful equipment.

Before the war, practically the whole of this area was virtually derelict by modern farming standards. The "dog-and-stick" farmer with his sheep and beef cattle was the rule, and to find a field under arable cultivation was a rare occurrence. But the war years brought a great change ; large acreages of the old *Agrostis*-dominated pasture were rather reluctantly broken up, and most of it sown with winter wheat. Some of these fields grew three or four crops in succession, often with disastrous results in later years.

After the war, the ravages of Take-all and Eyespot, the difficulties caused by "lodging," and the lack of enthusiasm for arable farming pointed towards a fairly quick return to grass, which did, in fact, occur with the relaxation of control. The situation now appears more stable and the overall picture is roughly 40,000 acres of tillage, 20,000 acres of temporary leys and 40,000 acres of permanent grass, a proportion of which is unploughable for various reasons. The tillage area includes some 14,000 acres of wheat, 15,500 acres of coarse grains, 2,000 acres of beans and 3,000 acres of bare fallow, the remainder being made up of smaller acreages of various other crops. The cattle population is fairly stationary at 30,000 head, whilst sheep have increased gradually to the 70,000 mark.

This area is one of fairly large holdings—85 per cent of the land is in farms of over 100 acres—and there is little specialization. Dairying features to some extent but the absence of a good water supply (a serious problem throughout the area) and a dearth of suitable buildings are limiting factors. Consequently, about 75 per cent of the livestock are intended for the beef industry, either to be sold out as strong stores or finished on the better pastures. The Whiteface is the most popular, with the Hereford × Shorthorn the favourite cross. Most farms rear some calves by one or other of the accepted methods, no one method predominating. Ewe flocks, which are now found on the majority of holdings, are mainly Kerry or Clun types. Suffolk, Wiltshire Horn or Oxford rams are used for crossing.

Strict rotations were at one time practically non-existent in this area, but the tendency now is towards a 7- or 8-course shift, based on a four- or five-year ley. The introduction of short, stiff-strawed wheat varieties and the chemical control of such weeds as herrif and cleavers have relieved the farmers of the worry of tangled and laid crops which were once a common sight on this inherently fertile clay. These factors, together with the great increase in the efficiency and numbers of combine harvesters, have helped to make the arable side of farming much more palatable to local farmers. Roots, although found on most farms, play no major part in the rotation ; usually they occupy the odd corner. On the other hand, it is noticeable that the bean crop appears to be returning to favour. The increased power and efficiency of the modern tractor have greatly enhanced the value of the bastard fallow, and hence the acreage of expensive bare fallow is gradually being reduced.

There are probably few districts in the country which are more dependent upon intelligent co-operation with nature than this Lias clay region but, with the aid of modern science, very few areas can produce results more satisfying both to pocket and country.

F. J. Bennison,
District Advisory Officer

Nitrogenous Dressings to Increase Protein in Cereals

It has been known for a number of years that the protein content of cereal plants can be considerably increased by the application of nitrogen fertilizers, the increase varying according to the time of application. Thus D. J. Watson(1), in *pot* experiments with wheat carried out at Rothamsted in 1930, showed that by varying the time of applying nitrate of soda the nitrogen content of the grain could be raised from 1.92 per cent in the nil pots to 2.22 for a March application, to 2.40 for one in mid-June, and to 2.66 per cent for one given on August 10. Reckoned as crude protein, the grain from the nil pots had 12 per cent and that from the pots dressed in mid-June 15 per cent. There was also a small increase in the crude protein content of the straw and chaff—from 3.07 to 3.28 per cent. These analyses were on the dry matter-zero moisture content. The variety used was Yeoman II.

In recent years the need for greater self-sufficiency has led many experimenters to examine the possibility of increasing output of protein on the farm by applying this comparatively old knowledge. As previously mentioned in this JOURNAL(2,3), experiments were started in Hertfordshire in 1949 on winter wheat, winter oats and spring oats to ascertain the effects of late-applied nitrogen on yield and protein content, as earlier results with

wheat had suggested that the increases might well be large enough to be of practical importance. Moreover, the development of aerial spraying and fertilizing had provided one possible solution of the problem of applying dressings to corn, even after ear-emergence.

To date, sixteen such experiments have been done with winter wheat, five with winter oats and fifteen with spring oats. The number of varieties concerned in each trial has varied from six to thirteen. In *every* case important increases in protein content have been obtained. As expected, this has been greatest in the grain, but whenever the straw has been analysed an increase has been shown there too.

The first three experiments on winter oats, which have already been reported(3), showed a response of 1.05 in the protein percentage of the kernel when 2 cwt. "Nitro-Chalk" was applied in mid-April, and a further increase of 0.95 from an equal *additional* dressing in mid-June. The total increase was, therefore, just 2 per cent. Two later experiments have confirmed these results with winter oats.

It is hoped to describe the detailed results of the more comprehensive trials with winter wheat and spring oats in articles to be published in this JOURNAL later in the year. Interesting and important differences between varieties of winter wheat *in yield and protein responses* have been shown, but no differences of a similar size have been found in twelve varieties of spring oats. So far as protein percentages are concerned, the main results can be briefly indicated.

The results of nine varieties of wheat tested at each of fourteen centres spread over four years, giving 126 comparisons in all, were as under. N2 indicates a dressing of 2 cwt. per acre "Nitro-Chalk" in mid-April, and N4 an equal additional dose in mid-June.

	No Nitrogen	N2	N4	Total Increase
Percentage crude protein in dry matter ..	11.37	12.00	13.67	2.30

(Protein has been calculated in the usual way, that is, by multiplying the percentage content of nitrogen by 6.25. A more accurate factor for wheat protein is 5.7).

It can be seen that the greater part of the total rise in protein is due to the June dressing, applied around flowering time. Significant differences between varieties were shown. For example, Holdfast, a high-protein wheat even on no-N plots, gave a greater rise than Bersée at thirteen out of fourteen centres, the total increase in protein being 2.59 per cent for Holdfast and only 1.50 for Bersée. For another wheat (N 59) in the same high-yielding class as Bersée, the increase was 2.28 per cent—also significantly above Bersée.

In the case of spring oats, the fertilizer dressings were the same, but the early one was usually applied in the second half of May and the late one in the second half of June. The results of six varieties tested at nine centres spread over three years, giving 54 comparisons in all, were :

	No Nitrogen	N2	N4	Total Increase
Percentage crude protein in whole grain	11.29	12.41	13.62	2.33

The total increase was almost exactly the same as for the wheat, but was produced in two almost equal steps. The biggest difference in the increase between varieties amounted to only 0.42 per cent, Star responding least and S.221 most. Unlike the cases quoted for the wheat, this varietal difference was not significant.

Another important result from the wheat trials is that they seem to have established a definite varietal difference in the *yield* response to April dressings of nitrogen. For example, Hybrid 46 has averaged 7.5 cwt. extra grain for 2 cwt. "Nitro-Chalk," whereas Vilmorin 27 has only given 2.6 cwt. These and other points will be considered in the later articles.

H. W. Gardner,
Hertfordshire Institute of Agriculture

BOOK REVIEWS

Four Thousand Million Mouths. Edited by F. LE GROS CLARK and N. W. PIRIE. Oxford University Press. 12s. 6d.

One of the most remarkable if untrumpeted achievements of the present century has been the widespread application of science to the production of human food. Already science has gone ahead of practice in many directions and is able to indicate methods by which, if they became practicable, food production could be greatly increased. The subject has lent itself to a certain amount of fanciful writing, which, if it does no harm, at any rate does little good. This book has the merit of combining clear and well-balanced presentation with dispassionate and sober expert treatment. It opens with a useful account of the Malthusian hypothesis by F. le Gros Clark, then follows an account by G. V. Jacks of methods of conserving the soil and avoiding erosion. This latter has sometimes been attributed to the rapacity of the cultivators ; actually it is commonly the result of using unsuitable methods, and it is being avoided by the development of better ways of land utilization. F. Yates summarizes the results of numerous experiments with fertilizers and surveys of their use : usually they offer the quickest and surest way of increasing crop yields. F. Bawden discusses crop diseases, emphasizing the need for more field staff and more educational work among the growers. S. C. Harland writes vigorously about crop improvement by plant breeding and indicates various lines worth following up. H. D. Kay gives a concise and able summary—one of the best we have seen—of methods of improving the milk supply ; and J. Hammond deals fully with production of pigmeat. The editors have wisely included two chapters on fish, of which far better use ought to be made. C. E. Lucas sets out clearly the problems associated with deep sea fishing : this yields a world total of 5 or 6 million tons at present but it could produce considerably more by good international co-operation. G. E. Reay and C. L. Cutting discuss the preservation and use of fish, a subject the neglect of which is responsible for much loss of good food. New ground is broken by A. C. Bacharach and T. Crosbie-Walsh in their discussion of the processing of food. N. W. Pirie deals with the circumvention of waste and incidentally does some summing up of the wider problems. The book is a valuable contribution to a vitally important subject, and it is one of the best that has yet appeared.

E.J.R.

British Tractors and Farm Machinery. (The Green Book) **Vol. II, 1953.** Norman Kark. 40s.

It is difficult in a few words to do justice to a comprehensive publication such as the 1953 Green Book, which is published in four quarterly issues. The first and main issue, which reaches subscribers at the beginning of the year, contains full specifications and illustrations of all British tractors, including market-garden and other specialized types ; reports on all tractors officially tested at N.I.A.E. ; a review of a wide range of British farm machinery and implements ; and a wealth of information on such items as British Standards for tractor details such as power-take-off and drawbar hitch locations, and three-point tractor-implement linkages.

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1. The Effect of Applying a Nitrogenous Fertilizer to Wheat at Different Stages of Growth. D. J. WATSON. *J. agric. Sci.*, 1936, **26**, 391
2. The Effect of Nitrogen Top Dressings on the Yield and Protein Content of Winter Wheat. H. W. GARDNER. *Agriculture*, 1950, **57**, 1-8.
3. Variety and Manurial Trials with Winter Oats in Hertfordshire. H. W. GARDNER. *Agriculture*, 1951, **58**, 208-16.

This publication is edited under the general guidance of the Tractor and Agricultural Machinery Section of the S.M.M.T., the Agricultural Engineers' Association, and the British Agricultural Machinery Manufacturers' Export Association, while much of the technical material is carefully vetted by the staffs of the manufacturers concerned. It therefore enjoys a large measure of backing from trade organizations.

The Green Book is printed on good paper which permits excellent reproduction of the many half-tone illustrations. The drawings and pictures of tractors and machinery are useful and attractive, but photographs of personalities in the industry do not seem to add anything of value to the directory of manufacturers, official organizations and associations.

Altogether, this is a publication of great value to all, both at home and abroad, who are closely concerned with the agricultural engineering industry.

C.C.

Farm Buildings. E. GUNN. Crosby Lockwood. 12s. 6d.

The reader of the fourth revised edition of this book will find little difference between it and the 1946 edition. Brief notes on the design and construction of calf boxes are new, and at the end of the same chapter some storage data is given—a practical idea of which more might have been made. The section on farm dairies is lengthened by the excellent reproduction of five designs prepared by the Fixed Equipment Committee of the Milk Marketing Board. The subject of milking parlours, milk rooms and farm dairies surely deserves a chapter on its own and not merely a place in a chapter on " Miscellaneous Buildings". A couple of pages on concrete blocks and mention of transparent roof tiles are brief acknowledgment of two building components not mentioned in the 1946 edition.

Interest in building costs today is keen, and therefore to repeat a table of 1935 costs in the 1952 edition is asking too much indulgence ; the explanation given that these costs are now very much more seems hardly necessary. The new chapter on farm cottages derives its merit from the interest which illustrated designs always command, but it is a pity that costs are omitted, except those for one design which we are told cost £400 in 1934. It is not clear what purpose the author had in including in an appendix certain rejected designs. If he is asking for sympathy against the authority concerned, then the reader will do well to remember that a text-book is no place for special pleading.

Altogether this book is disappointing. It has long been an old favourite and the issue of a new edition was an opportunity to present an up-to-date publication of considerable appeal at a time when value for money in building is of increasing importance. And one would have thought that a mention of the well-known " Fixed Equipment of the Farm " series of leaflets in the short list of useful references which the author gives at the back of the book, would not have been out of place.

R.G.A.L.

Scottish Farming in the Eighteenth Century. JAMES E. HANDLEY. Faber. 25s.

To write of the eighteenth century in Scotland is to choose a period, especially in agriculture, when a country was remade. The primitive conditions which prevailed at the beginning of the period and the slothful nature of the population became bywords to travellers from England. The threat of famine was never far removed from the inhabitants, but an agricultural revolution was in being, stimulated curiously enough by the union of the countries in 1707, for the necessity of travelling to London brought to the notice of the new representatives the marked contrast in agricultural methods. England, stimulated by Townhend, Tull and Bakewell and by arboriculturists, was pioneering new methods, and the intelligent landowners of Scotland, hitherto contented with their lot, proceeded to bring English methods into their own country. The relative taming of the Highland clans, the making of new military roads to put an end to rebellion, and the enclosures all added to progress, although a landless population was also created. Subsequently this surplus was absorbed by the industrial revolution of the nineteenth century.

The Scots were good pupils and by the end of the century they had secured their position as skilled farmers, gardeners and foresters and have remained in the van of progress to the present day. It was a remarkable epoch in every way, and gave the population new self-respect and a sturdy independence which had world-wide effect when they pioneered in other countries.

Dr. Handley has done justice to his subject. The work has involved considerable research, as is indicated by the very full bibliography, and the indexing has been carefully done. It is an authoritative publication, welcome to the student and a good source book for further study. It gives some indication of the value of the records in Register House, which have hitherto been singularly neglected.

T.B.M.

The Pig Farmer's Veterinary Book. N. BARRON. Dairy Farmer. 12s. 6d.

Dr. Barron has succeeded in producing an excellent little guide for all pig-farmers which goes a long way to answering the criticism that veterinary knowledge on pigs is more difficult to obtain than for the other domestic animals. The book is divided into eleven chapters, four of which deal in detail with health maintenance ; the remainder discuss the common ailments, with particular reference to how they may be avoided. An appendix contains the author's suggestions for the pig-keeper's veterinary cupboard. This is commendably simple, and serves to emphasize the theme that dominates the book, namely, that prevention is the best cure ; in other words, attend to the comfort and health of the pigs, and disease problems will be few. Unless beginners wish to learn the hard way, they should study the opening chapters with great care, since therein lies the key to successful pig-farming.

The author recommends sodium fluoride as the best remedy against roundworms in pigs, and rightly emphasizes that its use requires the greatest care, but he does not say whether all young pigs should receive treatment as a routine measure. I am inclined to think they should.

The book is well-produced, well-illustrated and right up to date. It should prove of great value to students and intending pig-keepers, while those more experienced will readily recognize that it embodies great experience combined with modern advances in the veterinary art.

W.L.S.

Commercial Cloche Gardening. J. H. L. CHASE. Faber. 16s.

The author of this book is to be congratulated upon bringing together in an easily readable form the information needed to develop cloche gardening for pleasure or profit. He has carried out extensive investigations of this type of gardening at Chertsey, and has drawn freely upon the knowledge obtained. In following his advice, the beginner can be sure he is on the right lines.

After describing the evolution of the modern cloche, Mr. Chase discusses the economics of commerical cloche gardening and the standard methods of two- and three-strip cropping. The chapter on " The Soil and its Management " centres around organic manuring, as indeed do all his recommendations regarding fertilizer treatment, despite the fact that he disclaims any desire to indulge in the organics versus inorganics controversy. There is an excellent chapter on " Cloche Management " and the subject of irrigation is dealt with in a very general way. Some seventy or more pages are devoted to the cultivation of vegetables, salads, fruit and flowers with the aid of cloches, and this section contains a great deal of excellent advice on cultivation details, choice of varieties, etc. The book ends with a chapter on packing and marketing. It is not surprising that the cloches referred to in this book are of the tent and barn continuous cloche type. Growers will remember, however, that there are other types worthy of consideration.

The book contains few serious mistakes, but one worth mentioning is the statement that *Botrytis* cannot attack the healthy parts of a plant. Again, the author states that there are a considerable number of *old-fashioned* growers who believe that inorganic fertilizers can be of use to them and do no harm to the soil. One is tempted to add that there are also some *old-fashioned* scientists who cling to the same belief! This perhaps we can overlook, but surely there is no excuse for the remark that "To succeed as a grower it is more important to be a shrewd business man than a trained horticulturist complete with B.Sc. and N.D.H."

These black spots apart, the book is friendly, as one expects all gardening books to be, and it can be strongly recommended to all who are interested in cloche gardening.

W.F.B.

A Farm Dictionary. Compiled by D. H. CHAPMAN. Evans Bros. 8s. 6d.

Seldom, if ever, does any farmer of my acquaintance, pause to consider the specialized vocabulary which he uses as a commonplace every day. And I think this would be true of the generality of farmers. The uninitiated "layman" therefore, whether student, prospective practitioner, or interested observer, has of necessity to learn what almost amounts to a new language before he can get far with that complexity of sciences which we embrace in the simple term "farming". A laurel awaits anyone who will extend a helping hand to the etymological halt and lame, and so Mr. Derek Chapman qualifies at once for high honour.

The publishers claim that Mr. Chapman has collected and defined over three thousand words and phrases in general farming usage. I accept their word for that ; I haven't counted them. But I can say that my sample testing of this dictionary has not disclosed any omissions, except of a minor order and not worth mentioning. Clearly it is going to be a very useful book indeed—to students of all ages, young farmers and, I will go so far as to say—old farmers too.

I was particularly attracted by the flashes of humour with which Mr. Chapman has set off some of his definitions—a rare, but acceptable, quality in a book of this kind. For instance, a belly-band is explained as " a strap fastened under the belly of a horse so that the cart it is pulling cannot tip over backwards—at least, not without flinging the horse over with it".

Again, a low-loading trailer is defined knowledgeably as " a type of vehicle whose floor is built close to the ground, so as to make loading up as nearly a pleasure as it is ever likely to be".

One more—for the economists—marginal land is neatly and simply explained as "land that it would be ungrateful to return to Nature, although it is only just worth the cultivating".

This is a book that merits a great success. Is it too much to hope that Mr. Chapman, or someone equally well gifted, will now add to our indebtedness by compiling a dictionary of farming dialect ? Such a man would be the Dr. Johnson of the twentieth century.

S.R.O'H.

The Discours Oeconomique of Prudent Choyselat. (The first book in English on Poultry Husbandry translated out of the French by R. E., with a preface by H. A. D. Neville, Professor Emeritus, University of Reading). 6s. 6d.

The enterprise of the School of Art at Reading University in reprinting this little book is to be commended. Quite apart from the high technical merit of this reprint, the choice of Choyselat's work was excellent. It professed to be a practical work describing the latest poultry husbandry of the times, but Professor Neville is convinced that Choyselat was not actually experienced. In 1580 exact science had not been developed, and the matter is plentifully garnished with what we now regard as superstition. The possible profits promised are stupendous : a net gain of 4,500 francs for an investment of 500 must have appealed to a soldier ruined in the French Civil Wars, though this estimate was a trifle illusory. It is to be hoped that the Count Rotchfort, for whose benefit it was written, was not unduly misled by it !

The Elizabethan age was devoted to fortune-telling of various kinds, and Choyselat interjects a description of what he called "Alectoromantia" or the " Divination of thyngs to come by Cockes ". The age was not less devoted to making money, and some of Choyselat's proposals for stimulating a market are entertaining. As Professor Neville says at the end of his preface : " The scarcity of the book, its unusual character and its historical interest . . . justify the appearance of this reprint . . .". For my part I could wish that others of our rare old English farming books might be reprinted in the same excellent way, perhaps by other University Schools of Art.

G. E. F.

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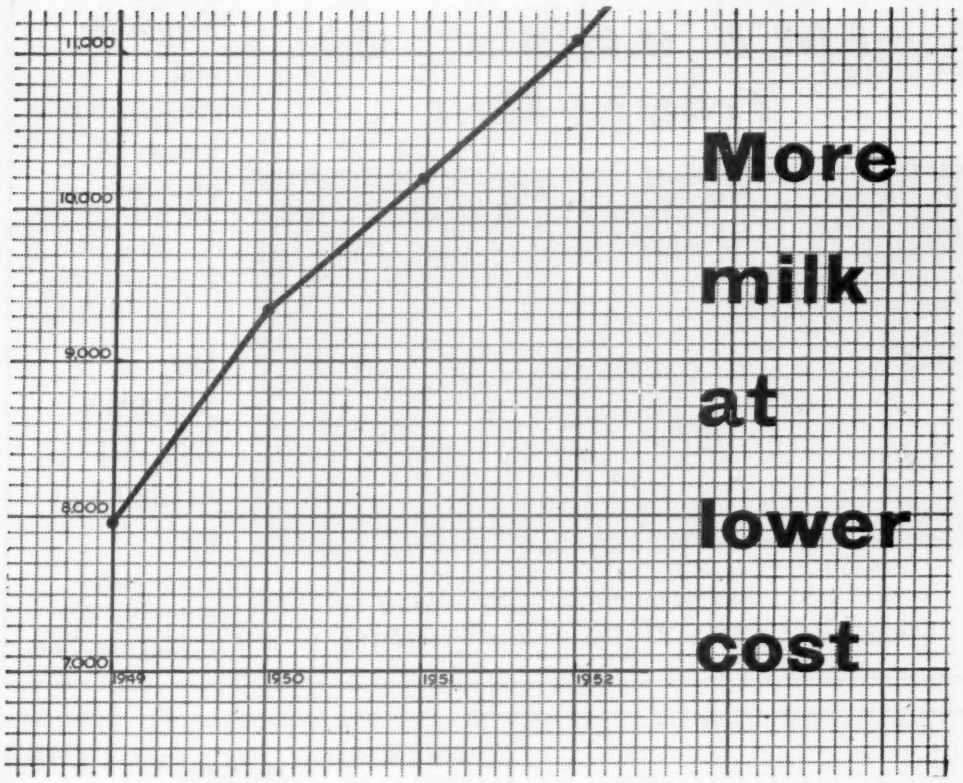

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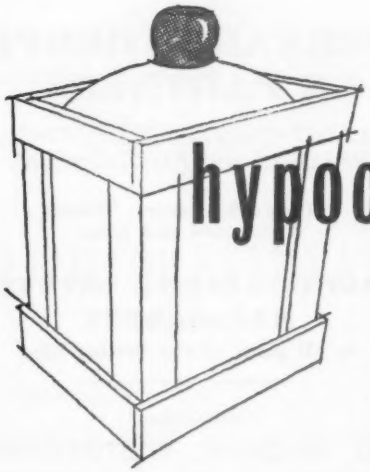

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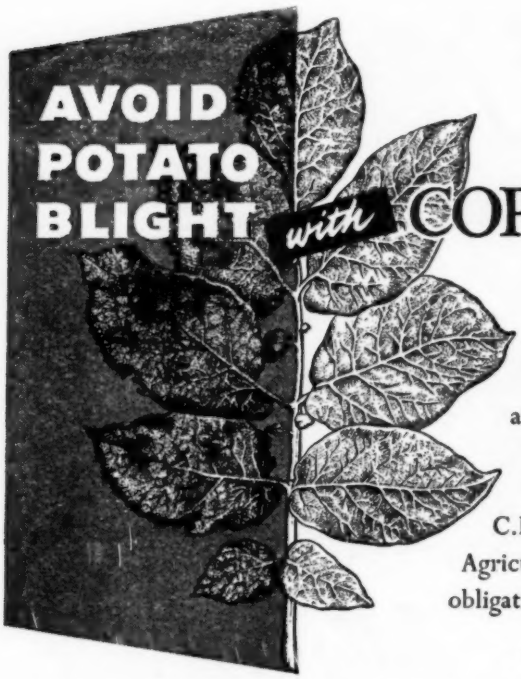

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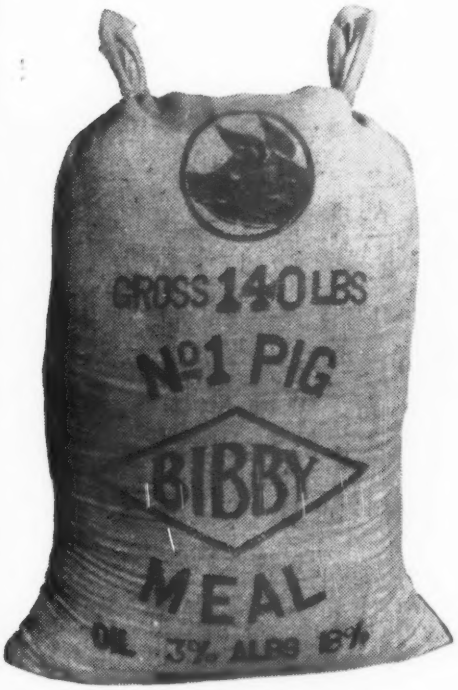

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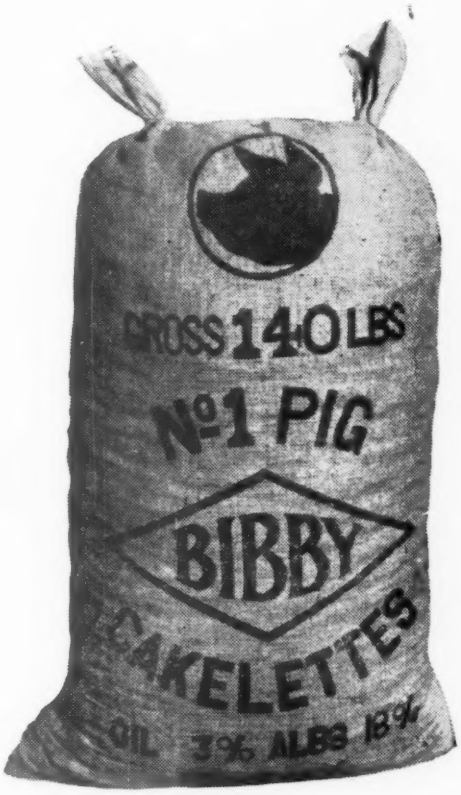

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